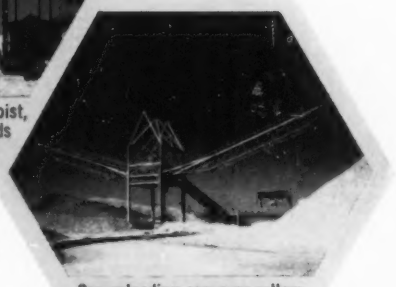
april 1958

nlgi spokesman

journal of the national lubricating grease institute

"In 14 months...not a single bearing lubrication failure with lithium-base grease!"

Conveyor-stacker handling moist, sticky material which builds up on the rollers.



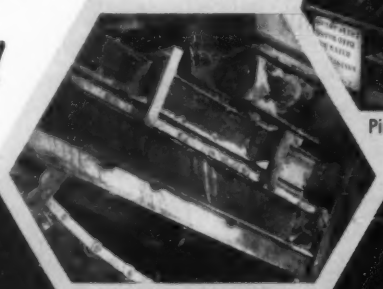
Ore unloading conveyor rollers handling 200 tons of ore per hour.

THE PROOF IS IN THE PERFORMANCE...

lithium-base grease does the job...

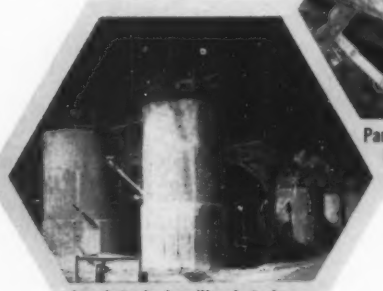
and does it better!

Pinion gear transmitting power from 600 h.p. motor to a ball mill.



Pan Conveyor handling hot clinker (1600°F), roller bearings in dusty, moist atmosphere.

V.A. Wemco classifier, part of wet grinding system, lower bearing submerged in hot sludge.



Leach tanks handling hot slurry, agitators driven by Falk gear reducing units.

Here's a report of our own experience with lithium-base grease under extreme industrial service conditions. Approximately 95% of the grease used in the plant of AMERICAN LITHIUM CHEMICALS, Inc., our subsidiary at San Antonio, Texas, is lithium-base, one-type grease. In fourteen months operation we have not been able to trace a single cause for bearing failure to the lubricant used. The on-the-spot photos above give graphic evidence of the rugged bearing service requirements in this plant where lithium ores are processed into high-grade lithium hydroxide, itself an important ingredient in lithium-base grease. Performance like this is why grease chemists, manufacturers, marketers and users all attest to the superiority of lithium-base... the *one* grease in place of *many* for efficient and economical operation.

TRONA
REG. U.S. PAT. OFF.

Want to know more about TRONA lithium hydroxide monohydrate? Send for our technical bulletin on this important chemical ingredient in lithium-base greases.

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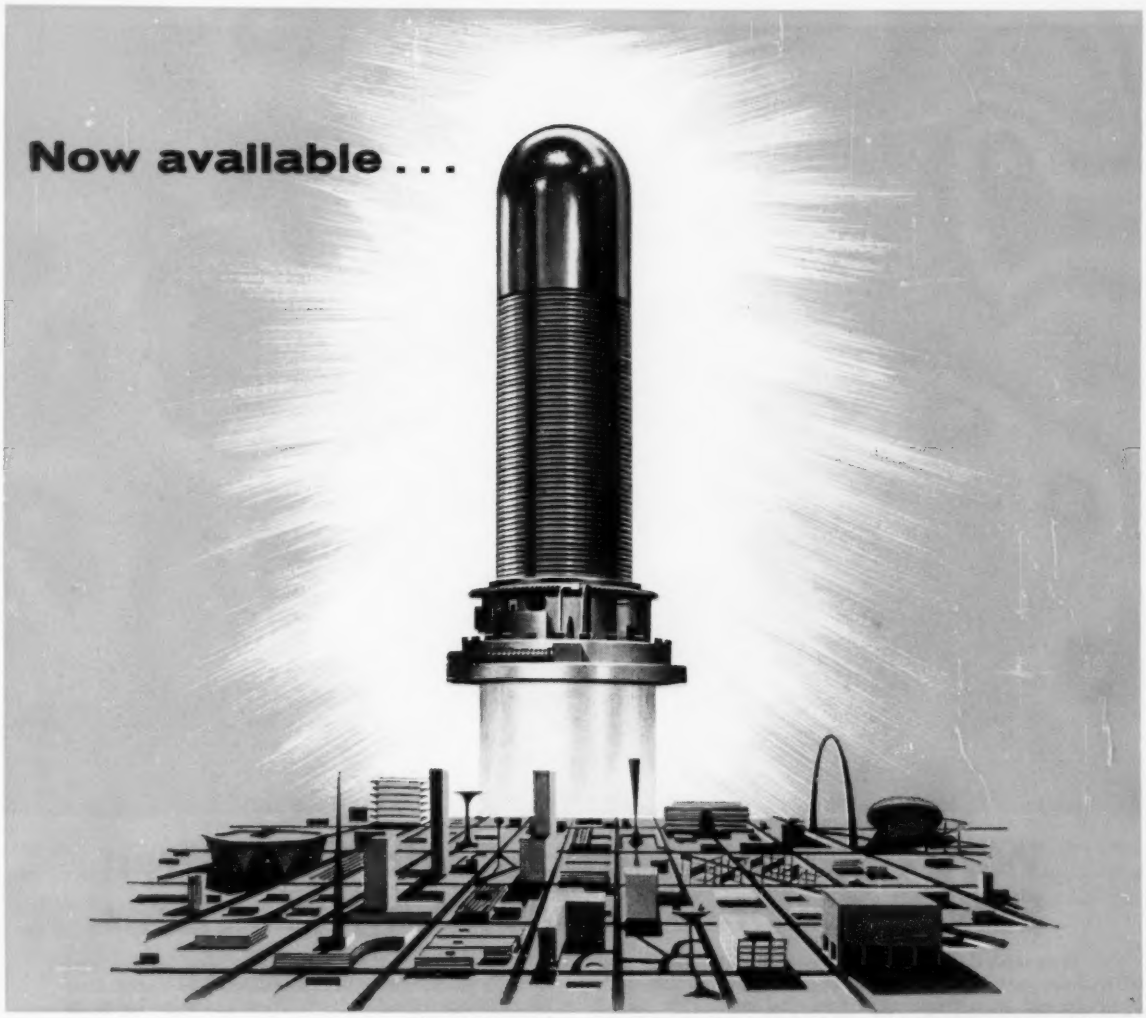

Van de Graaff electron accelerator recently installed at Shell's Emeryville Research Center is one of the most powerful sources of radiation available to industry.

a radiation-resistant grease for commercial nuclear applications

SHELL APL GREASE

Nuclear applications bring new complexities to the field of industrial lubrication. Not only is the lubricant required to withstand unusual service with respect to temperature, speed, load and oxidation, but it is also exposed to the damaging effects of neutron and/or gamma or beta radiation.

To meet this challenge, Shell Research has developed a practical radiation-resistant grease for use in nuclear reactors and their component parts . . . Shell APL Grease.

In Shell Laboratories, comprehensive tests have been conducted with the aid of a three-million-volt electron accelerator, one of the most powerful radiation sources in industry.

Gamma ray tests have shown that APL Grease will withstand an accumulated dosage of 1 x 10^9 roentgens. Another valuable finding reveals that APL Grease has superior thermal stability . . . it lubricates efficiently at 300 degrees Fahrenheit.

APL Grease is further proof of Shell's leadership in lubrication technology—and your assurance that Shell Research is ever vigilant to the pulse of industry progress.

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SHELL

NLGI PRESIDENT'S PAGE

By R. CUBICCIOTTI, *President*

The Research Fellowship of NLGI

In going over the results of the Institute's scholarship-research program, one cannot help but be impressed by the contributions this phase of our activities has made to the lubricating grease industry.

Aside from the concrete achievements in basic research for which our program has been responsible, the importance of this undertaking to the members of the Institute is threefold:

- It helps the individual members who are too often too busy with their day-to-day activities to cope with the problems they will have to face in the years ahead.
- It is an excellent means of developing the scientific talent of which the country and particularly our industry stands in such need.
- It serves as the symbol of our industry's sense of responsibility to the state of the art of producing improved lubricating greases to meet our nation's ever increasing demands.

There are many subsidiary reasons why our scholarship program looms so large in the scope of our endeavors. We need cite only a few to prove the point. For instance:

The Public Relations Aspect

Not only all sections of our industry, but industry in general, and, to some extent, the public at large, are being made aware of the contributions that our Institute is making to the program of science.

The Concept of Public Service

Long before President Eisenhower urged on the nation the need for training many more scientists to meet the challenge of the atomic and satellite age, the Institute had inaugurated a project that laid special emphasis on the encouragement of the training of technicians and scientists.

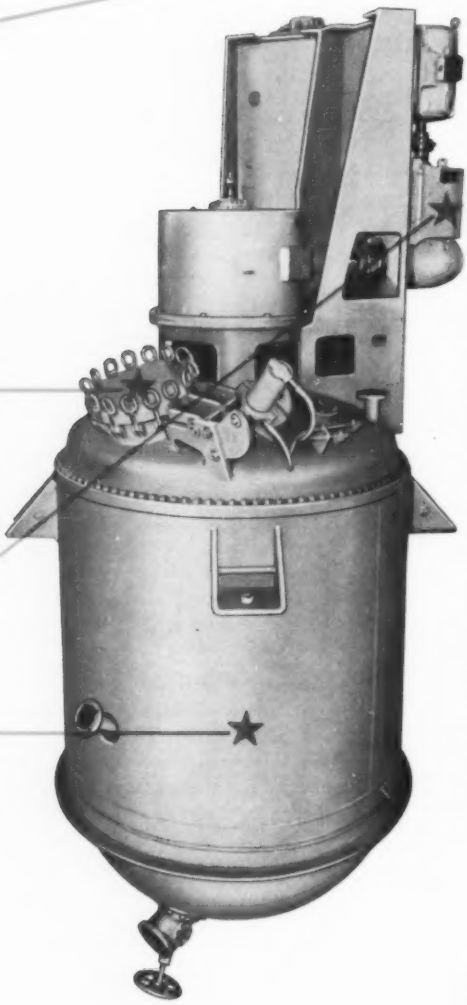
The Prospect of Stimulating Others

In many instances projects that are researched by the holders of the Institute's scholarships have a bearing, direct and indirect, on other industries. The latest example is the current research into the mechanics of direct flow at the University of Utah, which has been acknowledged to have important implications for the plastic and textile industries.

The evidence mounts up. It is no wonder then that we look forward with such great confidence to the achievement of ever greater results from our efforts to explore the problems of the future for the benefit of the lubricating grease industry and of mankind. ■

13,500 POUNDS of GREASE

every 8 hours!



Struthers Wells

DOUBLE MOTION GREASE KETTLE

This is a stainless steel grease mixer recently completed for one of the major oil corporation's grease plants in Texas. All parts in contact with the mix are made of clad or solid type 304 stainless steel.

Note particularly the new vertical drive arrangement that permits maximum aisle clearance around the unit . . . also the newly-designed hydraulic-operated manhole with special built-in safety features. These are typical of Struthers Wells leadership in modern, efficient grease making equipment.

Are you searching for improved efficiency in your mixing operations? Struthers Wells will help you find it quickly with equipment designed to meet your specific requirements.

STRUTHERS WELLS PRODUCTS

PROCESSING EQUIPMENT DIVISION
Crystallizers . . . Direct Fired Heaters . . . Evaporators . . . Heat Exchangers . . . Mixing and Blending Units . . . Quick Opening Doors . . . Special Carbon and Alloy Processing Vessels . . . Synthesis Converters

BOILER DIVISION
BOILERS for Power and Heat . . . High and Low Pressure . . . Water Tube . . . Fire Tube . . . Package Units

FORGE DIVISION
Crankshafts . . . Pressure Vessels . . . Hydraulic Cylinders . . . Shafting . . . Straightening and Back-up Rolls

STRUTHERS WELLS *Corporation*

WARREN, PA. Struthers Wells Plants at Warren and Titusville, Pa.

Representatives in Principal Cities

News About NLGI

Derby Refining, Raffineries Imperator, Sumner Sollitt Company Join Institute

Six new members have joined NLGI since the first of the year . . . three of these member firms were accepted in February and include:

Derby Refining company of Wichita, Kansas has joined as a Marketing member. Mr. W. B. Neil will serve as both Company and Technical Representative to the Institute.

Raffineries Imperator of France has been accepted as an Active member . . . NLGI representatives have not yet been named.

Sumner Sollitt company, engineer division of Chicago, has been accepted as an Associate member with Mr. A. J. Barth listed as Company Representative and Mr. B. G. Twyman serving as Technical Representative.

Other companies now participating in Institute affairs as members since the first of the year include Maruzen Oil of U. S. with headquarters in New York, Battenfeld Grease and Oil of New York at North Tonawanda, and Waverly Oil Works of Pittsburgh. All three are manufacturers (Active) and have been mentioned in earlier issues of the SPOKESMAN, but NLGI would like to welcome again all new members, at this time.

Numbered Consecutively

Beginning with this issue of the NLGI SPOKESMAN . . . Volume XXII, Number 1, the magazine pages will be numbered consecutively through each issue for the total twelve magazines in the volume. This is a practice suggested by several members and conforms with most technical journals for ease in indexing.

Change in Representatives

Tidewater Oil company has named Dr. L. W. Doolan, Jr. as their NLGI Company Representative, replacing Mr. John T. McCoy, who has had a change in company assignments. Dr. H. E. Achilles will continue to serve as the firm's Technical Representative.

Hope That Production Survey Data Will Go Out in Mid-April

As this is written, a full month before the deadline on production data, the response to the NLGI production survey has been most heartening . . . more than two-thirds of the Active members in the United States have already mailed back their questionnaires ahead of the March 31 closing date. A total of 64 manufacturers were sent forms from Ernst and Ernst, the

Continued, page 59

SERVICE AIDS

Send Orders to: National Lubricating Grease Institute, 4638 Nichols Parkway, Kansas City, Mo.

NLGI MOVIE — "Grease, the Magic Film," a 16-mm sound movie in color running about 25 minutes, now released. First print $600, second print $400, third and subsequent orders $200 each (non members add $100 to each price bracket).

VOLUME XX — Bound volume of the NLGI SPOKESMAN from April, 1956 through March, 1957. An excellent reference source, sturdily bound in a handsome green cover . . . $7.00 (NLGI member price) and $10.00 (non-member) plus postage.

VOLUME XXI—Bound volume of the NLGI SPOKESMAN from April, 1957 through March, 1958. Contains 34 articles and features dealing with lubricating greases and gear lubricants . . . $7.00 (NLGI member price) and $10.00 (non-member) plus postage.

BONER'S BOOK—Manufacture and Application of Lubricating Greases, by C. J. Boner. This giant, 982-page book with 23 chapters dealing with every phase of lubricating greases is a must for everyone who uses, manufactures or sells grease lubricants. A great deal of practical value. $18.50, prepaid.

- Withstand higher operating temperatures (Up to 75° hotter than lithium based greases)
- Are water resistant (GA-10 greases are insoluble in water)
- Give improved bearing performance (last as much as 2-3 times longer than ordinary soap based greases)
- Have superior work stability (hold up better under severe operating conditions)
- Are resistant to radiation damage from X-Rays, gamma rays, beta rays and neutrons (GA-10 greases maintain good gell structure up to 500 megaroentgens of gamma rays)
- GA-10 greases have higher ASTM dropping points (in excess of 580°F.)
- Are compatible with other types of greases
- Have excellent pumpability in either pressure or automatic feed systems (GA-10 greases are faster flowing than most soap gelled greases)

The unique properties of Oronite GA-10 gelling agent makes possible the production of high performance grease lubricants for a variety of applications. Whether you make multipurpose grease lubricants, automotive greases, aircraft, marine or special purpose greases you can now make them better with Oronite GA-10.

Call or write the Oronite office nearest you for detailed information.
Send for technical bulletin describing properties of Oronite GA-10.

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nlgi spokesman

Volume XXII APRIL, 1958 Number 1

Published Monthly by the National Lubricating Grease Institute, T. W. H. MILLER, Editor; SUSANN SNYDER, Assistant Editor, 4638 J. C. Nichols Parkway, Kansas City 12, Missouri. Telephone: VAlentine 1-6771. 1 Year Subscription, $5.00. 1 Year Subscription (Foreign), $6.00

IN THIS ISSUE

THE COVER

THE famed NLGI Wheel Bearing Manual has just had its fourth reprinting—first published by the Institute in 1954, this handy booklet has sold more than 100,000 copies and distribution has been made throughout the world . . . it has been reprinted in seven different languages. On page 25 the manual is again offered in its entirety in the pages of the NLGI SPOKESMAN to reacquaint readers with this service. Our cover illustration shows an important step, as outlined phase by phase, in "Recommended Practices for Lubricating Automotive Front Wheel Bearings," by men of NLGI.

The NLGI SPOKESMAN is indexed by Industrial Arts Index and Chemical Abstracts. Microfilm copies are available through University Microfilm, Ann Arbor, Mich.

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Presented at the NLGI 25th annual meeting in Chicago, October, 1957

Development of an Extreme High Temperature Grease

By I. W. Armstrong and H. A. Woods
Shell Oil Company

PRIOR to 1940 most industrial high temperature grease needs were satisfied with petroleum base soda soap greases. Since that time interest and research in this field has been increasing at a rapid rate. The military have been the main stimulus for this activity due to the varied conditions encountered in the operation of air, sea, and land equipment. Thus, the first of the high temperature military grease specifications to be written was ANG 5a in 1944, which called for 300 hours bearing performance at 300°F. This and other military grease specifications outstanding at that time caused grease manufacturers to place primary emphasis on performance in ball bearings at elevated temperatures. In 1951 the specification MIL-L-3545 was issued calling for a minimum of 600 hours bearing performance at 300°F. To meet this performance requirement carefully selected oils, new soap bases, and effective oxidation inhibitors were required. This specification still stands and products meeting the requirements of this specification comprise the majority of today's high temperature greases. This will not long be the case.

As aircraft people are beginning to speak of speed in Mach numbers rather than miles per hour, and terms such as aerodynamic heating, reduction in drive mechanism size, payload, rocket and guided missile become prevalent, greases are again being scrutinized as to high temperature performance. In 1955 a major increase in bearing performance was called for with the introduction of MIL-G-25013 (USAF) which requires a minimum of 500 hours performance at 450°F. A grease passing the 600 hour test at 300°F might be expected to last approximately 20 to 50 hours at 450°F. Also included in this specification is a low temperature apparent viscosity requirement at −65°F.

In conjunction with the issuance of this specification, a CRC panel was set up to select a bearing test rig for screening greases at 450°F. This work was recently completed and the decision has now been made to ex-

tend the 450°F. requirement and to develop the changes in metallurgy necessary to adapt the tester to 600°F and eventually 700° to 750°F operation. This is a strong indication of the direction current thinking is taking in the high temperature grease field.

When MIL-G-25013 was announced, we undertook the preparation of an extreme high temperature grease with the performance level of this specification as the

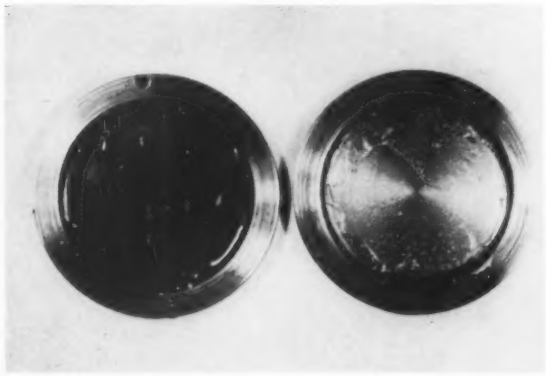


FIGURE 1

immediate goal. Involved in this program was a rather extensive reappraisal of the available gelling agents, oils, and test methods. It was common knowledge that the conventional soaps and mineral oils would not provide the necessary thermal and oxidative stability. Through background experience[1,2,3] the silicones were selected as the only commercially available fluids possessing the desired volatility, oxidation stability, and viscosity-temperature characteristics. Laboratory tests indicated that a methyl phenyl polysiloxane would be stable throughout the temperature range of this program. Although the particular oil does not provide the −65°F apparent viscosity requirement of MIL-G-25013, it was selected because of its superior high temperature stability. The selection of this base oil limits service application to rolling contact ball bearings or systems other than hard steel against hard steel, due to the well known lubricity deficiencies of this class of compounds.

Potential grease thickeners were selected on the basis of general high temperature properties, i.e., melting point, oxidation resistance, thermal stability and other reported physical data. Compounds were considered from three general classes, namely, (1) inorganics, (2) metal organics, and (3) organics, dyes, and miscellaneous compounds. Simple and effective bench tests were chosen to screen these materials prior to rig testing. The compound was first rated as to its ability to get oil. This often involved developing dispersion techniques peculiar to each individual thickener. A large share of the compounds did not form satisfactory gels and were eliminated at this point. A finished grease was then rated as to its mechanical stability and general appearance. The next and perhaps the most valuable screening test was a thin film oxidation test.[4] This test gives an indication of the structural and chemical changes that occur when a thin film of grease is subjected to high temperatures. It also gives a measure of the effect of the thickener on volatility of the base oil. One gram of grease is spread uniformly in a depression

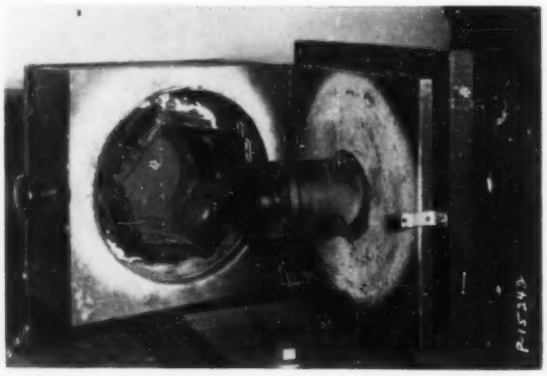


FIGURE 2

two inches in diameter and 0.188 inch deep, in a mild steel plate and placed in a forced draft oven at 450°F for 4 and 24 hours. Weight loss of volatiles is measured at 4 hours. At the end of the 24 hour period the greases are rated according to changes in color, consistency, texture, weight loss, and tendency for oil separation. This test, while simple, was quite effective in selecting products for rig testing.

For bearing tests at 450°F the NLGI-ABEC test spindle was used at 10,000 rpm with Marlin Rockwell 204 S-17 bearings. These bearings are made of high speed tool steel with silver plated beryllium bronze cages and are made with greater than normal internal clearance. Figure 1 is the thin film oxidation test showing a grease before and after heating. Note the marked color change in this particular sample which incidentally is a product that was rated a failure. Figure 2 is a photograph of the NLGI-ABEC Bearing Test Rig.

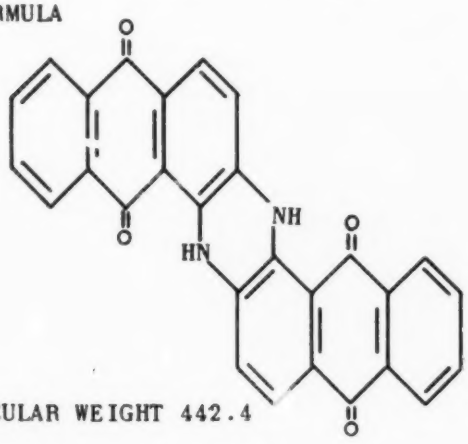
From the preliminary screening tests the following general conclusions were drawn. The inorganic compounds, such as silica and clays, require a surface coating as a waterproofant. In general the thermal stability of these waterproofants limits high temperature performance of these materials. The metal organic compounds were similar to the conventional soaps in thermal stability. Only products from the third classification showed promise as high temperature grease thickeners. It developed that of the compounds selected vat dyes were the most stable. A majority of these compounds are prepared by caustic fusion followed by extensive oxidation. In addition, in order that they might be absorbed on fibers, their particle size must be very

small. Fine particle size is also a prime requisite in the preparation of colloidal gels.

The thermal stability and gelling efficiency of the Indanthrene series of vat dyes has proven particularly promising. Greases prepared with the methyl-phenyl silicone fluid and the parent compound of this series,

INDANTHRENE BLUE RS

FORMULA



MOLECULAR WEIGHT 442.4

DECOMPOSES AT 875-900°F

FIGURE 3

Indanthrene Blue RS, have given outstanding performance. The chemical formula of this compound is shown in Figure 3. An excellent illustration of the stability of this material is its decomposition point (in air) of 875° to 900°F. It should also be noted that this compound contains the quinone and nitrogen groups found in some common oxidation inhibitors. As will be demonstrated later, oxidation inhibition is provided to some extent in greases prepared with this thickener.

Properties of Grease

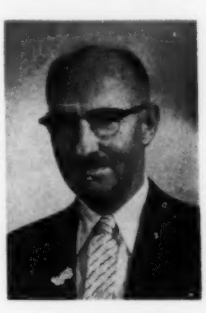
As might be expected from its name, greases made with Indanthrene Blue RS are deep blue in color as shown in Figure 4. The dispersion obtained with this dyestuff in oil resembles the type of gel structure seen in some soaps. Figure 5 is an electron micrograph of the dye as received. Magnification here is approximately 20,000 diameters (the small markers on the side of the photograph are on micron apart). Figure 6 is an electron micrograph of the dye dispersed in oil. The particles are arranged in the familiar jack straw configuration seen in some stable soaps. Maximum particle length is in the range of three microns and the particles have an average minimum unit width of 500 Angstroms.

Performance of a methyl phenyl silicone fluid thickened with Indanthrene Blue RS is compared with the requirements of MIL-G-25013 in Table 1. This grease provides 450°F bearing performance well beyond the 500 hours minimum of this specification. As mentioned before, this grease does not provide the low temperature properties of this specification because the base oil was chosen specifically for extreme high temperature service. Lower viscosity and more volatile silicone fluids are available which will provide the low temperature apparent viscosities of MIL-G-25013, but at some sacrifice in high temperature performance. As shown, this grease is water resistant, has an extremely low evaporation rate at 400°F and gives no pressure drop in the bomb oxidation test after 100 hours at 250°F.

Mechanical stability of this grease is extremely good as evidenced by as little as 20 points softening after working 100,000 strokes in the ASTM Grease Worker. In addition, this product shows no softening in the Shell Roll Tester after rolling four hours either at room temperature or at 212°F. After rolling 500 hours, it softens but 50 points and retains the characteristics of a grease.

ABOUT THE AUTHORS

J. W. ARMSTRONG *graduated from Westminster college, Salt Lake City in* 1951 *with a B.S. in chemistry. He then served two years in the Army Chemical Corps. On discharge from the service he joined Shell Oil company at Martinez, California. Armstrong has been in the grease research section where he has been concerned with the formulation of high temperature greases. He belongs to the American Chemical Soc.*



H. A. WOOD *has been associated with Shell Oil company, Martinez, California, for over* 23 *years, progressing to his present position of group leader in charge of grease research. He was born on Russian Hill in San Francisco and attended the University of California, receiving his Ph.G. degree in pharmacy in* 1925, *and his Ph.C. the year following. As time permitted, Woods joined the salmon fleet in Alaska and toured extensively in Mexico. He is a member of ASLE and several ASTM and CRC committees, and has contributed twice previously to the NLGI* SPOKESMAN, *in August '55 and March '57.*

FIGURE 4

FIGURE 5

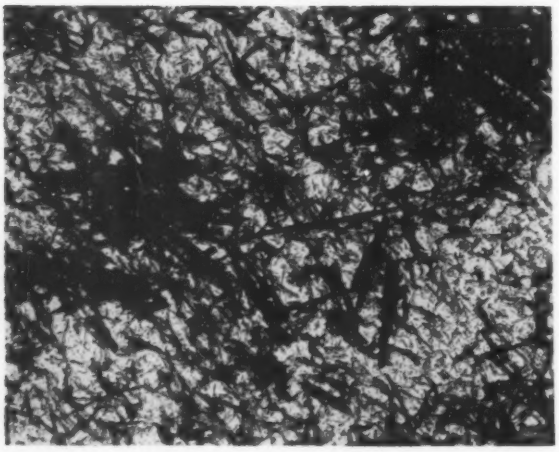


FIGURE 6

Table 1

PERFORMANCE AND PROPERTIES
INDANTHRENE-SILICONE GREASE VS MIL-G-25013-A
(USAF)

	Indanthrene Silicone	*MIL-G-25013-A*
Dropping Point, F°	>550	Min 500
Worked Penetration	Passes	260-310
Bomb Oxidation, 100 hr, 250°F Loss, psi	None	Max 5
Water Resistance, Loss %w	None	Max 50
Evaporation, 22 hr, 400°F, %w	1.33	Max 4
Apparent Viscosity, −65°F, Poises at 20 sec^{-1}	(1500 at −45°F)	1500
High Temperature Performance, 450°F, Hours to fail	1181	Min 500

To determine the performance life of this product at various temperatures beyond 450°F, additional bearing tests have been conducted in the NLGI-ABEC Test Rig. A summary of these results is shown in Table 2. The data listed represent the average performance life of at least two tests run according to the CRC L-35 procedure with 20 hours running on temperature and 4 hours down. These results indicate that this product has significant performance life at temperatures up to 600°F. Until recently grease lubrication at this temperature was impractical.

Table 2

HIGH TEMPERATURE PERFORMANCE
NLGI-ABEC TEST RIG, 10,000 RPM
CRC L-35 TEST PROCEDURE

Temperature, °F	*Hours to Fail*
450	1,181
500	621
600	162

Incidentally, evaluation of the indanthrene-methylphenyl silicone greases in the Fafnir Friction Oxidation Test apparatus indicated that a soft number 0 grade of

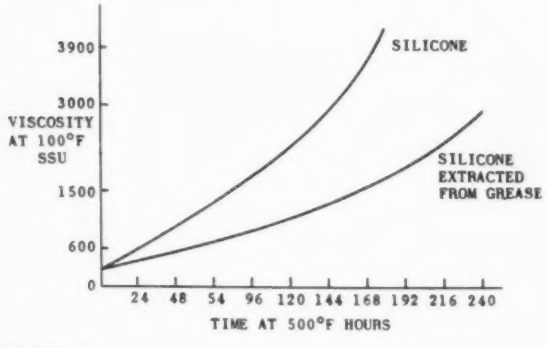


FIGURE 7

this grease allows only 0.1 milligram bearing loss to place it among the best greases evaluated in this tester.

To further illustrate and explain the high temperature performance of the indanthrene-silicone greases, the oxidation inhibitory properties of the thickener were demonstrated by placing 20 gram samples of grease and oil in a forced draft oven at 500°F for various time intervals and measuring viscosity increase of the base oil and oil extracted from the grease. Results of this experiment are shown in Figure 7. After 150 hours the oil had begun to polymerize quite rapidly and at 190 hours had gelled. Conversely, the oil extracted from the grease was still fluid after 240 hours under these conditions. This is demonstrated visually in Figures 8 and 9. Here duplicate samples of greases have been placed in spherical wells one inch in diameter

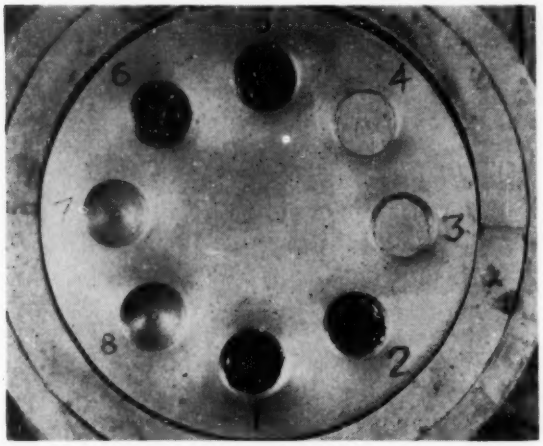


FIGURE 8

and ¼ inch deep in an electrically heated aluminum block and heated in air for 24 hours at 650°F. Figure 8 is the grease before heating with identification counterclockwise as follows:

Samples 1 and 2: Indanthrene-silicone grease

Samples 3 and 4: An extreme high temperature grease

Samples 5 and 6: MIL-L-3545 Grease

Samples 7 and 8: Silicone oil

Figure 9 is the same block after heating. One sample of each product has been stirred with a spatula to rate consistency. The indanthrene grease is still quite soft and buttery, the high temperature grease has darkened considerably and is quite dry and pasty, the 3545 grease has turned to glass and the oil has gelled to a hard rubber.

The oxidation inhibiting effect of this thickener has also been demonstrated in a modified Dornte oxidation test[5] in which oxygen was bubbled through a diester oil with and without 5% Indanthrene Blue RS and containing both copper and iron wire as catalysts. As shown in Table 3 the oxygen absorption rate of this oil was cut in half by the presence of the thickener.

Samples of the methyl-phenyl silicone grease have been distributed to a large number of aircraft and

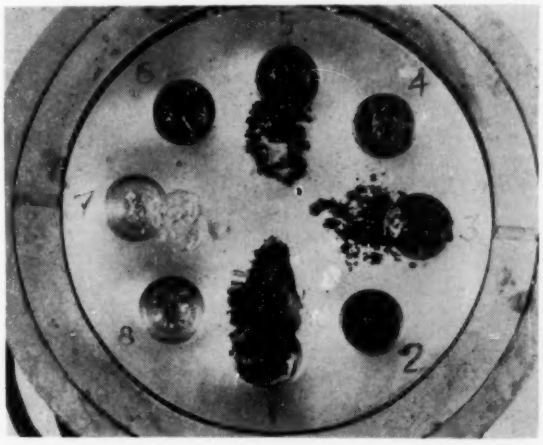


FIGURE 9

bearing manufacturers in this country for evaluation. To date all field trial results have been encouraging.

Table 3

DORNTE OXIDATION TEST, 300°F

	Diester	*Diester +5% Indanthrene*
Time (Hours) to Absorb		
250 ml Oxygen	1.5	3.7
750 ml Oxygen	2.3	4.9
1500 ml Oxygen	4.7	10.0

Conclusion

The oxidation resistant nature of Indanthrene Blue RS is such that the development of more stable oils will permit its use in greases operating under conditions even more adverse than those presented here.

Acknowledgment

The authors wish to thank Messrs. H. M. Trowbridge and F. A. Anderson for their assistance in the evaluation of the series of greases presented in this paper.

We would also like at this time to thank the dyestuff manufacturer, the General Dyestuff company, for their cooperation in this program.

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By ALLEN A. ARMITAGE
L. M. Gilbert Co.

can make more trips

AWARE OF THE EMPHASIS today on package appearance and the proven sales appeal of a well "turned out" product, companies using steel shipping drums are concerned about reconditioning whether they are "set up" to do it themselves or are having it done. Since the price of new drums has been increasing constantly, reconditioning has proven to be of sound economic benefit to most companies.

Drum reconditioning has grown from a dubious process in 1945 to an almost universally accepted procedure today. Two main factors having an influence on reconditioning's acceptance are: good machinery designed for its many phases, and the ability to produce a good finished package necessary to compete with new drum users.

The so called "oil drum" is considered to be the easiest to recondition. However, its use by a highly competitive industry demands careful attention to the details of processing.

The first problem facing a company, regardless of size, is whether to recondition themselves or have the work done by established reconditioners.

Cost, in most cases, is the deciding factor. However, there are some intangibles which are worth mentioning. Usually it is difficult to induce the outside reconditioner to consistently produce the type package de-

Presented at the IOCA tenth annual meeting, Cleveland, September, 1957

sired. An inspection program involving the customer's personnel is required and a more or less constant negotiation conducted between both parties to keep the standard of the reconditioned drums at a satisfactory level. The larger the customer the more personnel required, but partially offsetting this, the reconditioner is more willing to please the large customer due to his volume of business. The small customer unfortunately

". . . reconditioning has proven to be of sound economic benefit to most companies"

becomes prey to the whims of the reconditioner's business expediencies and often has trouble getting his work done on time and to his satisfaction. Ofttimes the small customer as well as the customer having a drum requirement up to 400 or 500 a day, hesitates to embark on a reconditioning program, due to lack of complete understanding of what methods and machines are available for the purpose. There are many degrees of reconditioning and to avoid confusion, I will confine my remarks to a broad plan which would seem to suit most oil companies.

In addition, since 55 gal. drums are in more prevalent use, I base these remarks on 55 gal. drums, although with few exceptions, machinery is universal and will handle 15 and 30 gal. drums as well.

The first step in reconditioning is sorting, classifying and preliminary drainage of excess residues. In the colder climates, where drums are stored in the open, steaming nozzles are helpful in thawing residues to encourage drainage flow. Bungs are also removed at this point and batched for their subsequent cleaning.

A good general purpose machine for stripping exterior paint as well as interior cleaning and interior de-rusting is an immersion type washer-chainer. This is a simple machine with a minimum of maintenance problems. It consists of a tank with steam coils or gas fired heat exchangers which are capable of keeping the cleaning solution at a high heat level. A 10 to 15 per cent caustic soda solution with additives and wetting agents is commonly used. Since alkaline cleaning agents are more efficient at elevated temperatures, an opportunity to keep solution at maximum efficiency is afforded. This is not generally true of spraying systems unless continuous heat exchangers are installed on discharge side of pumps. When the drum is placed in a tank, it fills with the cleaning solution through bung openings and it is supported on and rotated by power driven shafts. Specially designed mechanical seals at tank wall have proven remarkably efficient both as to sealing ability and power consumption and are replacing the old maintenance ridden stuffing box. The mechanical action obtained by rotating the immersed drums compares with the best flat jet spray and experience has shown that paint will strip faster and more completely with the immersion type washer. A drum with one coat of paint will strip in about five minutes, whereas drums with several coats may take as long as 15 minutes by inserting special cleaning chains in the drum before placing it in the tank. Thus, it is possible with one machine to clean the inside and the outside, strip paint and de-rust the inside body at one station. The one disadvantage of this machine is the inability to get the drums to and away from the cleaning stations conveniently when using more than a two or three drum capacity machine.

An adaptation of the combination immersion-rotating machine is called a "traveler". This machine uses the same principles of the washer-chainer, but is loaded with drums at one point only. Drums, while immersed and rotating, are conveyed through the required number of stations and are up-ended from the tank to the drain rack automatically. After draining, drums may be down-ended and exteriors rinsed with hot water at an included rinsing station. After rinsing, drums are automatically ejected from the machine. Since this machine lends itself to automatic control, it is well received by those concerns interested in increased production with decreased labor.

Machines can be furnished completely automatic with no operators chargeable to the machine itself. The conveyor speed may be adjustable to accommodate batched drums requiring different cleaning times. In addition, all drums receive the same cleaning time cycle automatically, which is not true of the washer-chainer, since the operator must remember how long each drum is in process.

The cabinet type washer is another machine which may be used to wash the interior and the exterior of drums as well as strip paint. This machine comprises a

cabinet housing the interior and the exterior flat jet sprays, a cleaning solution storage and heating tank, and an access door for loading and unloading. The operator places the drum in the cabinet and inverts the drum over the single interior oscillating or rotating nozzle designed to completely spray the interior surface of the drum. Some machines, however, are designed with a stationary interior nozzle, causing some loss in the cleaning efficiency, but having a lower initial investment.

Since the drum is stationary during the cleaning operation, paint stripping is not efficient unless a bank of exterior nozzles is rotated or oscillated. Drum bungs limit the flow of sprayed material from the interior and the spray volume must be kept at about 10 g.p.m. maximum or a skip cycle spray and drain system should be used. Sometimes a continuous vacuum system is introduced through the interior nozzle to permit an increase in the spray volume. A small vacuum system is commonly used to continuously evacuate the spray from the depression created by the drum chime projection and the drum bottom which is uppermost when the drum is inverted.

A minimum cycle of five to six minutes is required to strip one coat of paint and production requirements determine the number of cabinets required. These machines will not remove rust, but can be made to rinse the exterior and the interior of the drum as well as dry it with a corresponding increase in time.

Another washing combination is possible by using an "outside stripper" which is used for washing and rinsing exteriors only. This machine can be completely automatic and comprises a suitable number of drum rotating stations arranged over a drain trough. Canopy jet sprays cover the exterior of the drum as it rotates and a hot cleaning solution drains back to the storage tank for re-heating and re-circulation. The drums advance to succeeding stations automatically. However, the cycle is easily altered. The exterior of the drums are rinsed with hot water and ejected from the machine. Following this, they are manually inverted over rotating or oscillating interior sprays for interior cleaning and rinsing. While the exterior work is automatic, considerable handling is required for processing from one machine to the other. Provisions are not available for interior rust removal with this system of cleaning.

When the cabinet washer and the combination outside-inside cleaning arrangement are used, a separate machine is necessary for interior body rust removal. A chainer is commonly used for this purpose. The chainer has a number of adjacent drum rotating stations mounted on a common cradle capable of being slowly oscillated through an arc of approximately 180 degrees.

Cleaning chains and a few gallons of caustic soda cleaning solutions are inserted in the drum. Then the bungs are closed tightly. The drum is placed on rotating shafts and oscillated as it is rotated. The chains scour the body and the heads, although the job done on the heads is not as good as that done on the body. A separate head and bottom chaining machine is available to take care of badly rusted heads. This machine rotates and undulates the drums in a nearly vertical position allowing the chains to completely scour the heads.

A drum inspection should be made after the washing and chaining operation. Chains and residue are then removed and if the cleaned drum is not satisfactory it is returned to the appropriate process station.

Interior rinsing is a simple matter when the drum is inverted over a hot water spray nozzle machine and the rinse water discarded.

There are other refinements to drum reconditioning which may be mentioned without regard to their sequence since this varies with the plant layout.

A chime machine rounds and leak seals the drum ends or chimes. There are several models from the single end machine to the high production automatic double end machine. The relatively inexpensive single end chime machine is satisfactory for production of 800 to 1000 drums a day, but does require an operator.

Dent removal is obtained by chucking the drum in a de-denter. Air or water is introduced into drum under pressures up to 100 p.s.i. which is sufficient to

". . . there are many different machines with a variance in design, to suit particular conditions."

remove most of the dents. The air machines are the speedier but have some undesirable characteristics. The top head is not de-dented, because of equalized pressure between the inside and the outside of the drum head. This situation exists, due to the type of seal used on air machines. Substantial safety measures must be provided for operating personnel in case a drum should explode while under pressure. The noise resulting from such an explosion is tremendous. The water hydraulic de-denter is limited to about 200 drums per day per station. It has none of the disadvantages of the air de-denter and creates no danger to the operator. It is more economic initially and in operation. Water is pumped into drum and air vented until the drum is filled and under water pressure. While under pressure, small dents, not ordinarily removed by pressure alone, may be set by the operator using a hand mallet. Water is then pumped from de-dented drums to fill another drum in multi-station machines or a storage tank in single station machines. One of the main benefits of hydraulic de-denting is the ability to determine and locate drum leaks. Water under pressure gives a positive means of leak detection and unlike air, the location of leaks is plainly evident.

Outside de-rusting is most economically performed by a brushing buffer. This machine utilizes power driven wire brushes to cover the body and ends while the drum is rotated by a power driven cradle. Patented spring loaded brush arms follow the contour and brush over runners and into dents without damaging the brushes.

Some larger consumers use sand blasting machines for rust removal but these have high initial as well as high maintenance costs.

The drying of rinsed drums is done in two ways. The syphon dryer first syphons the rinse residue, not completely drained from the drum, and creates a flow of room air with considerable velocity through the interior of the drum. For best results, the drum should be at an elevated temperature when arriving at the syphon dry station. The resulting flow of the room air gradually cools the drum and minimizes future condensation problems. The hot air dryer is the other machine in common use. Room air is continuously heated, using steam, gas fired or oil fired heat exchangers. Heated air is forced at high velocity through a header and out of the vertical pipe nozzles over which the drums are inverted. The drum does not have to be at an elevated temperature to dry quickly, but does require the use of a separate small syphon unit to remove the rinse residue. Drums, hot air dried, must not be bunged too tightly if condensation on cooling is to be avoided.

Painting is accomplished on paint stands which rotate the drum resting on tapered power driven rolls. The operator spray paints the drum usually with an air operated gun. There are several model stands to suit plant layouts and production.

Some refinements associated with painting are preheating, "phosphatizing," paint baking and drying. These are commonly understood processes and there are many different type machines for this purpose with a variance in design to suit particular conditions.

The price of equipment for reconditioning oil drums varies with the type, size and production requirements. Generally speaking, only unskilled labor is needed to operate a drum plant since the machinery involved needs no special skill. The maintenance man is an important part of drum reconditioning because a break down of one key machine usually shuts down production until repaired. A properly maintained plant should carry adequate spares for known wearing parts, but, unfortunately, this practice is not too prevalent in the drum reconditioning industry.

The current actual cost of reconditioning an oil drum in the Philadelphia area is about $1.25 but the mark-up varies greatly. Reconditioned drums, painted one color, are selling currently at $4.25 for random end closures. Side filler drums run about $4.00 each and specified head fillers such as Tri-sure, sell for about $4.50. New drums on the East Coast are priced at $6.46 each for head fillers and $6.56 each for side fillers in lots of 100 or more. As you can see, any process which permits your drum to make more trips is worthy of your utmost consideration. ■

About the Author

ALLEN A. ARMITAGE *attended Temple university, has had eighteen years of experience in the drafting and design of machinery used for special purposes. For the past twelve years he has been a machine designer and sales engineer of the L. M. Gilbert company, specializing primarily on drum reconditioning equipment and wire stone sawing equipment. Because much installation time is necessary on his various projects, Armitage travels extensively in the United States and abroad, is considered an outstanding international expert in the increasingly important field of steel drum cleaning equipment.*

lubricating greases: a summary of facts and opinions as presented by the . . .

American Lithium Institute Survey

EDITOR'S NOTE: In the summer of 1957 an extensive survey was conducted by the American Lithium Institute, an NLGI Technical member, on various aspects of the lubricating grease industry. The firms contacted were taken from the rolls of the National Lubricating Grease Institute Active (manufacturing) members in the United States, and replies were received from 31 companies . . . about half of the NLGI domestic producers. Questionnaires and personal interviews were employed, and in almost every case the research workers were aware of the company and personnel of the company replying (as opposed to an anonymous survey of the type NLGI is now making on 1957 production). It should be stressed that many of the points given below are based on *opinion* and do not necessarily reflect industry trends except as answered by those complying with the questions in the survey. The material was reviewed and accepted by the Marketing Editorial Committee of the NLGI SPOKESMAN to be presented as a service to members from a reportorial, not an interpretative standpoint . . . these opinions do not necessarily reflect the thinking of the officers or members of the Board of Directors of NLGI. Finally, the American Lithium Institute survey should not be confused with the recently released API-Bureau of Census survey of lubricating grease and oil *sales* for 1956, or the current NLGI survey on *production* of lubricating greases and gear lubricants for 1957. The editors would like to thank Mr. Marshall Sittig, director of the American Lithium Institute and NLGI Company Representative, for allowing this report to be published first in the NLGI SPOKESMAN, *as a service to the industry*.

1. In answer to the question "What base greases do you produce?" the following types were listed (figures indicate the percentage of firms stating they produce that type): Sodium 100 per cent; Calcium 100 per cent; Lithium 72 per cent; Aluminum 33 per cent; Bentone 28 per cent; Lead 22 per cent; Barium 18 per cent; Non Soap (other than Bentone) 11 per cent; Combined bases (lithium-calcium, etc.) 11 per cent; Strontium 11 per cent; Zinc 6 per cent; others 6 per cent.

Only eleven firms were able to supply figures on the approximate percentage of their production devoted to each base type. The percentages for sodium ranged from a low of 2 per cent to a high of 50 per cent, and for calcium from 3 per cent to 64 per cent. Six of the eleven reported they are producing lithium base greases. The percentages varied from 14 per cent to 50 per cent. Four firms gave figures for bentone greases —two of them very low (under 2 per cent) and two

relatively high (over 35 per cent). One company indicated that 1 per cent of its production is in strontium grease.

2. Lithium was indicated most frequently as the grease base expected to increase in importance within the next few years.

Approximately 66 2-3 per cent of the grease producers participating in the survey produced more lithium base grease in 1957 (based on first six months) than for the same period in 1956. Practically the same percentage witnessed increases the year before as well. Most expect a continued increase for 1958—anywhere from 5 to 10 per cent over their present output. The general feeling is that lithium's rise in percentage of total grease production has about 3-5 years to go before leveling off or dropping. Some, however, feel that the leveling off is at hand now.

Silicone gels, bentonites and amines all are expected to enjoy at least some degree of increase within the next few years. Sodium greases are predicted to decline slightly, but there is some feeling that if a good complexed sodium base could be developed the reverse would be true. Feelings toward barium are mixed—one firm in particular (not now producing a barium grease) thinks it has excellent possibilities. Some indicated they do not expect it to ever become very widely used.

3. The fats and fatty acids indicated to be in use included a variety of tallows (beef, mutton, etc.); lard oil; maleic acid; stearic acid; neatsfoot; hydrogenated fish oils; 12 hydroxy stearic glycerides. Beef tallow appears to be the most widely used of all fats.

Several firms indicated that their choice depended to a large extent on economics, and therefore the types they use change frequently as prices change. Not too many companies felt that there would be much change in the future—thought the same fats and fatty acids important today, will be important tomorrow. One company looks to some form of rapeseed oil as a possible factor. Castor oil is generally expected to grow in use.

4. Some 39 per cent of the companies participating in the survey report that they are producing greases with synthetic fluids as well as conventional oils. Most of them indicated that synthetics accounted for only a small proportion of their total output, however, generally for military specifications. Silicones, sebacates, azelates and diesters were all listed as being used, with silicones mentioned most frequently.

5. Some 28 per cent of the companies not currently using synthetic fluids expect to use them in the future, but on a very limited scale (combine this with the 39 per cent now using them and it would make 67 per cent). Although silicones are the most widely used now, many companies feel that the diesters have a better future.

6. Both graphite and moly were indicated as being widely used (66 2-3 per cent of those answering are using each). Opinion differed somewhat as to how moly should be classified. The majority considered it an additive but some felt it to be a filler. Graphite was almost universally considered a filler. Zinc oxide was the third most widely used (40 per cent said they're using it). Old time fillers such as asbesto, mica, carbon black, chalk and the like are scarcely being used at all. Moly is the only material for which a bright future is expected, although many feel that graphite will continue to be used because some customers demand it.

Oxidation inhibitors, rust inhibitors and various E. P. agents seem to be in growing use. About 35 per cent said they are using one or all of these types of additives.

7. The total portion of grease production being consumed for industrial purposes seems to be on the increase. A rough estimate indicates that 60 per cent still goes to automotive (both commercial and passenger car), but even rough estimates cannot be taken too seriously because some companies consider farm equipment in with automotive, others classify it with all non-automotive uses and still others put it in a class by itself.

In general it is believed that industrial equipment will continue to rise in total grease consumption and automotive will remain about the same (individual cars will use less annually but more cars on the road will offset it).

8. The production of solid thickener greases is on the increase, but most firms are producing them only for specialty purposes. The general consensus seems to be that they will continue to grow in importance but will not compete with soap type greases to any extent. The most optimistic prediction was that they will grow to 20 per cent of the total grease market within a few years—but most estimates were more in the realm of 7-10 per cent. The vast majority of grease produced for many years to come is expected to be soap based.

Among non-soaps, silica gel is looked to for increased growth in the future at a greater pace than other solids. A few producers report they are currently experimenting with silica and urea thickeners.

Some of the drawbacks cited for solid thickeners include: (1) corrosion inhibitors and anti-oxidants break down solid thickener greases more readily than soap-based greases; (2) soaps provide manufacturers with greater control of the entire grease production operation; (3) some solids will not stand shock or pressure; (4) price in general is higher than soaps.

9. Twenty-two per cent of the companies polled are producing soap complexed greases. Opinion was almost unanimous that complexes will be increasingly important. About 40 per cent who are not now making complexes expect they will in the future. This combined with those now producing them, would bring

the total to 62 per cent. Total poundage of complex soap greases is not expected to be great, however. Most companies feel that they too will fall in the specialty category.

10. In discussing the wholesale price picture, most grease producers feel that there must be a general price rise before long. A study of prices reported shows that on an average, companies are marketing their standard multi-purpose greases for only 1c per pound more than in 1955. Some of the specialty greases have increased up to 10 per cent in that period, but prices in general are thought to be some 5 per cent lower than in 1951.

The steadiness of grease prices is attributed to increased production which has helped to offset rising crude oil costs. Further growth in demand is looked to, particularly for specialty greases.

11. Some expansion of grease manufacturing facilities was reported, although no large-scale expansions are in progress. Five plants are being (or recently have been) modernized and expanded. Two companies expect to build new plants in the not-too-distant future.

NLGI's own survey on the 1957 production of lubricating greases and gear lubricants will be mailed immediately to members in mid-April. Non-members desiring copies of the survey data may purchase the results from the national offices shortly thereafter, at ten dollars per survey copy.

Several others look for expansion of their existing facilities.

12. Midwestern grease producers in particular cited the grease cartridge as the most important development in the industry in many years. They expect it to continue to grow in importance—one firm predicts 30,000,000 cartridges will have been produced in 1957. It is generally felt that the price factor surrounding cartridges is becoming less important due to a jump in price of steel containers and the increasing demand by consumers for convenience. Failure of earlier attempts at cartridges were attributed to the eras in which they were introduced (the original came out during depression days) and the fact that they were not as convenient and practical as the present cartridges.

Two companies in particular look to other new packaging innovations. They see plastic-lined cardboard packages or plastic bags as possibilities.

13. A need for intensified and improved promotion of automotive greases was expressed by several. Despite a decrease in lubricating points on cars, it is felt that a constant effort to remind and convince drivers to have their car lubricated more frequently would have tremendous results in increasing grease sales.

ADDITIONAL INFORMATION

Comments from Suppliers to and Customers of Grease Industry and Some Grease Producers Themselves

A number of non-grease producers—customers of and suppliers to the grease industry—and some grease producing firms were contacted in personal interviews. Here are a few of their comments not directly related to the questionnaire.

1. As far as bearing manufacturers are concerned there is not an entirely satisfactory multi-purpose grease on the market. A great many different types of grease are currently being specified by bearing makers today.

2. Suppliers of fats and fatty acids report that their prices have not changed appreciably over the past two years. Menhaden fish oil is said to be the most significant industrial fish oil today and steadily increasing in popularity.

3. Preformed soap producers think that soap complexing would tend to further the decline of the preformed soap market. Although it is felt that pre-formed complexes could be made, this probably would not prove practical—grease producers would most likely find it more economical and better all-'round to make their own.

4. The Chek-Chart corporation has compiled figures showing that the average number of chassis lubricating fittings on passenger cars dropped from 18.7 in 1953 to 17.4 in 1956. This was a continuation of a trend begun in 1951 when the average was 25.2.

The average manufacturer's recommendation for intervals between chassis lubrication changed favorably for grease producers, however. It was 1,045 miles in 1956 compared to 1,051 in 1955. A total of three (3) 1956 cars carried recommendations for lubricating every 2,000 miles, but they represent only 8.56 per cent of the total cars produced and did not appreciably affect the over-all average.

5. The opinion among many suppliers (both fats and soaps) is that before long it will be all synthetic oils where greases for jet planes and jet engines are concerned. Another opinion concerns sealed-for-life bearings. Several believe that because the ordinary auto mechanic and farmer do not lubricate properly, bearing and machinery people will more and more trend toward sealed for life bearings. Speculation as to how this would affect the grease industry varies, but majority opinion is that it will increase the grease market and decrease the lubricating oil market.

6. The Earle patents, covering the invention of the use of lithium with fatty acids, will expire in March, 1959. After that time no further royalties will be paid on it. This should result in savings of about ¼c per pound on lithium greases. The use of 12-hydroxy

stearic acid with any metallic base, has three more years to run. But this affects not only lithium, but any metallic base combined with 12-hydroxy stearate.

In 1956, 150,000,000 pounds of lithium grease were produced. Assuming that 1 per cent lithium was used, that means about 1,500,000 pounds of lithium carbonate equivalent were used.

7. In addition to the farm market, many see the contracting field as a heavy user of grease cartridges. Also general purpose, for the home.

One opinion is that the grease cartridge is not here to stay—a type of cartridge was tried 25 years ago without success and ten years ago another type was again tried unsuccessfully. This firm feels that ultimate cost of the grease is 60 per cent higher when packaged this way (30c per pound compared to 18c).

Many think the reason the original cartridge idea did not go over is because it was aimed at the service station level and also it was introduced during depression times when people were more interested in economy than in convenience. They feel it was 20 years ahead of its time then.

8. There is a move on to standardize packaging by the Petroleum Packaging Institute. They are conferring with the NLGI and API.

The move for standardization in packaging is important to the industry. Before, every drum manufacturer had his own dimensions. For good materials handling, it is important that drums be the same height, and other dimensions. The Petroleum Packaging committee has worked with the Steel Container Institute to get agreement that drums be made to certain dimensions. This is now being done. The new standards conform to the American Standard association.

9. Some firms are experimenting with a corrugated carton and a plastic liner to replace drums. One firm is experimenting with a one quart plastic bag for motor oil. This would prove a problem in filling equipment, however.

10. The Anti-Friction Bearing association does not see where sealed bearing is any threat to the grease industry at this time. Sealed bearings can be and are opened for relubrication.

Expect prepacked bearings to be more of a factor in future. Some front bearings for tractors are now being used—and they're sealed with a grease, not an oil.

In the railroad industry and in electric motors lubricating oil was formerly the most widely used lubricant. But grease is now being used extensively in these applications, thanks to the sealed bearing.

Only the New Departure division of General Motors (Bristol, Conn.) claims to have a sealed bearing that is "lifetime lubricated."

11. Some have found that antioxidants and inhibitors, although advantageous in some respects, are very tricky. Degel can be easily caused by the wrong choice of material.

12. One grease producer has found that waterproofing properties of silica and other synthetic bases can be improved considerably by the addition of a high boiling alcohol.

13. One company (grease producer not presently using it), thinks that barium has fine potentials as a base. Thinks it has greater heat and water properties than lithium and far greater water properties than bentonite.

Hydrogenated castor oils are most commonly used with lithium of all the bases.

14. Ford reportedly has more fittings in 1957 than in 1956, which indicates trend to less fittings is not universal.

15. In addition to price, a drawback of silicone oils is their shearing action. They are not a sliding lubricant. But they can be combined with molybdenum to overcome this and, in fact, they are.

Ballbearings, conveyor belts, kilns and ovens, pressure packings for extruders—these are typical examples of where silicone greases reportedly are effective. They are not used to any degree in aircraft or automobiles.

Silicone fluids in greases reportedly offer advantages in temperature range. They do not smoke or break down, won't liquefy and flow away upon heat. They will withstand temperatures as high as 700°F. and as low as −100°F.

16. Aluminum soaps have practically dropped out of the picture as a factor. Up until five years ago they were a very significant factor.

Lithium and aluminum are the only two bases of any significance at all in preformed soaps.

When synthetic oils are used, preformed soaps are practically all that are used. If these should increase in use, preformed soaps would again be important.

17. The future of the sodas in the grease industry appears to be somewhat unpredictable. Lithium base greases appear to have decreased the importance of soda greases. But it appears that there will always be a certain demand for soda greases by those desiring a reasonably good lubricant at a lower cost.

18. There is a growing trend in the use of molybdenum in lubricants. Sales of this additive are expected to increase some 45 per cent this year over 1956 (based on the first six-months actual sales of Climax Molybdenum company) and an equal jump in 1958 appears likely. In light of the fact that the molybdenum disulfide market (for lubricants) in 1956 was approximately 450,000 lbs., this would mean about an 800,000 lb. market for 1957 and a million pound market for 1958.

19. The quantity of mica used in greases today is not large. The Wet Ground Mica association estimates that from 150 to 200 tons are used in greases. The demand does not seem to increase, but does seem fairly constant. ■

4th PRINTING

NLGI'S "Recommended Practices" Reprinted Again to Meet Demand the World Over

That longtime "best seller," NLGI's famed *Recommended Practices for Lubricating Automotive Front Wheel Bearings* has just had its fourth printing to meet continued demand.

First published in 1954, the handy sixteen-page booklet represented the work of more than 200 experts and three years of effort, as members combined to eliminate one of the major industry problems.

Because *Recommended Practices* has always been considered exceptionally complete and accurate, a constant flow of orders and reorders has come into the national offices for the past three and a half years . . . orders ranging from one copy to many thousands.

Around the Globe

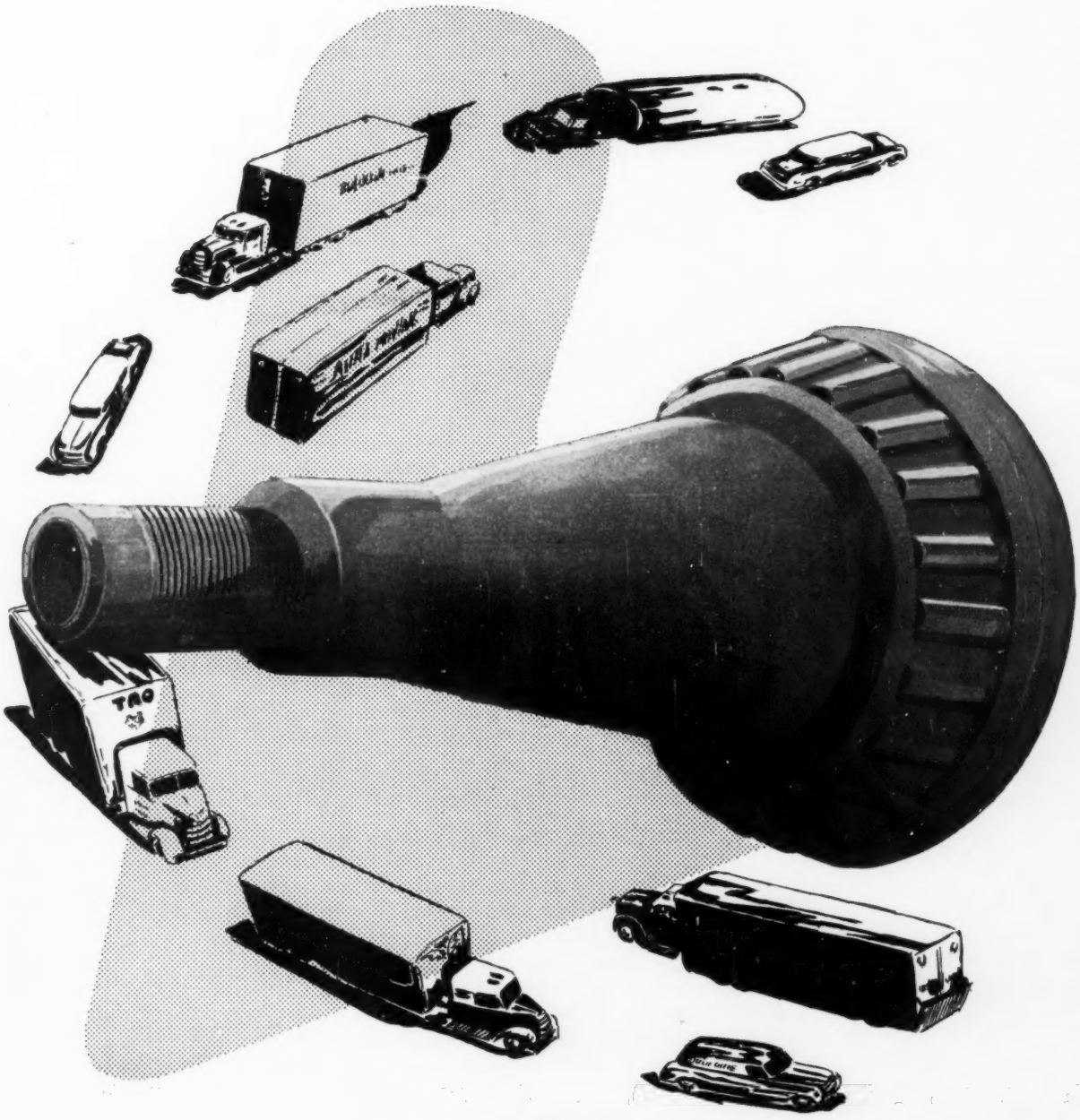
Distribution has been world wide, and where unusual circumstances intervened, *Recommended Practices* has been translated into different languages in order that overseas employees of member firms might take advantage of the care which went into the preparation of the manual. More than 100,000 booklets have been put in use over the years, both at home and abroad.

Shown in its entirety beginning with the next page, the manual is again available for reorder in any quantity, with discounts on larger orders (see page 39 for prices).

Company advertising or public relations imprints may be added on the final page at very little extra cost, along with extra colors for company insignias. Inquiries should be addressed to the national office.

RECOMMENDED PRACTICES

for Lubricating Automotive Front Wheel Bearings



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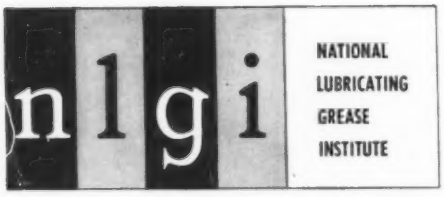

ESTABLISHED 1933

The National Lubricating Grease Institute is a technical and marketing association for the lubricating grease and gear lubricants industry. Its objectives include development of better lubricating greases and gear lubricants for the consumer, and better lubrication engineering service to industry. A monthly journal, the NLGI SPOKESMAN, is recognized as the leading magazine serving consumers of lubricating grease and the lubricants industry.

Second printing, 1955
Third printing, 1957
Fourth printing, 1958

FOREWORD

In view of its influence on safety and handling, the lubrication of automotive front wheel bearings is one of the most important lubrication services performed on automotive vehicles. It is also, perhaps, the most complex of the routine automotive lubrication procedures; it is the one service where satisfactory performance not only depends on the quality of the lubricant used, but also on the skill with which the various steps are performed.

Because it is a complex procedure, most vehicle and lubricant suppliers have developed recommendations for performing the service. In many cases, however, these recommendations have differed so much in individual detail that they have only served to confuse the user.

These problems were discussed in the Technical Committee of the National Lubricating Grease Institute, and it was concluded that if the lubricating grease industry could agree to a common procedure of known effectiveness, this could result in more satisfactory wheel bearing lubrication. Consequently, at the 1951 N.L.G.I. Annual Meeting, the formation of the Subcommittee on Recommended Practices for Lubricating Automotive Front Wheel Bearings was authorized. The following subcommittee which was formed included all the members of the Institute who volunteered as a result of their experience in this type of activity.

H. L. Hemmingway, Pure Oil Co., Chairman
Warren A. Brown, Kerr McGee Oil Industries, Inc.
M. L. Carter, Southwest Grease & Oil Co.
Melville Ehrlich, American Lubricants, Inc.
Walter J. Ewbank, Cato Oil & Grease Co.
J. W. Lane, Socony Mobil Oil Co.
G. H. Link, Shell Oil Co.
L. W. McLennan, Union Oil Co. of California
W. E. Pope, Consumers Cooperative Assn.
C. C. Schrotberger, Jesco Lubricants Co.
Wilson Simmons, Southwest Grease & Oil Co.
Martin Stark, Esso Standard Oil Co.
Merle Turner, Sunland Refining Corp.
R. M. Welker, Gulf Oil Corp.
O. L. Yarham, Cities Service Oil Co.

The members of the Subcommittee gave generously of their time in the preparation of the initial drafts. The greatest portion of the work of assembling the suggestions and comments into a final procedure was carried out by Mr. P. V. Toffoli and Mr. R. A. Shewry of the Technical Service Department of the Pure Oil Company. The assistance of Mr. A. R. Idzepski of the Studebaker Corp., and Mr. R. J. Mahaffay of the Chek-Chart Corp. is also gratefully acknowledged.

October, 1954

NATIONAL LUBRICATING GREASE INSTITUTE
4638 J. C. Nichols Pkwy., Kansas City 12, Mo.

INDEX

Recommended Practices for Lubricating Automotive Front Wheel Bearings

IMPORTANT—*Dealer personnel obtain authorization for replacement of defective parts.*

INTRODUCTION

The re-lubrication of front wheel bearings is one of the most important services performed in the maintenance of equipment. The two points to be emphasized on this service are **cleanliness** and **adjustment.**

Cleanliness

The utmost care should be exercised in maintaining cleanliness. This means that all the component parts of the bearing assemblies, the brake mechanism, and the grease should be protected from dirt and grit while the work is being carried out. Cleanliness should also mean that all the old lubricant be removed, both from the hub and the bearings, even if the old lubricant has the same appearance as the new lubricant.

Adjustment

The most careful job of re-lubrication can be performed on the bearings and the results spoiled by incorrect adjustment. Therefore, extreme care should be taken in making the correct adjustment of the bearings.

NAMES OF WHEEL BEARING PARTS

Component Parts of a Roller Type Front Wheel Bearing (Figure A)

1. Hub cap
2. Dust Cap
3. Cotter Pin
4. Spindle Nut
5. Washer
6. Cone of Outside Bearing
7. Cup of Outside Bearing
8. Hub
9. Cup of Inside Bearing
10. Cone of Inside Bearing
11. Grease Retainer
12. Spindle

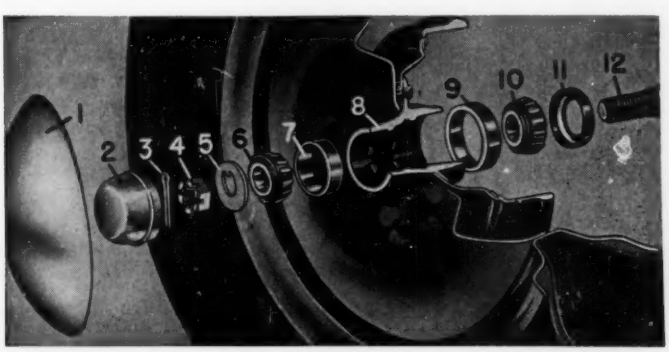

Figure A

Component Parts of Ball Type Front Wheel Bearing

(Figure B)

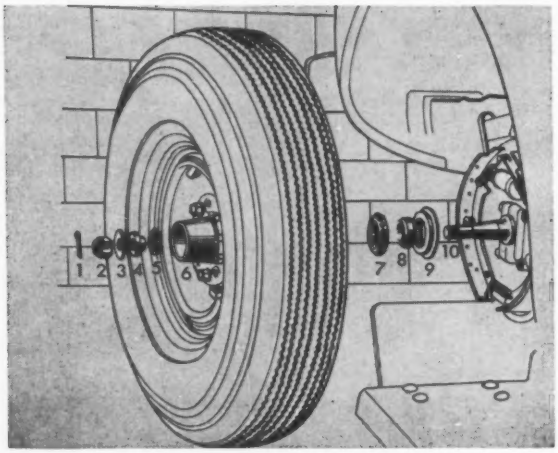

Figure B

1. Cotter Pin
2. Spindle Nut
3. Washer
4. Inner Race of Outside Bearing
5. Ball Assembly of Outside Bearing
6. Hub
7. Ball Assembly of Inside Bearing
8. Inner Race of Inside Bearing
9. Grease Retainer
10. Spindle

(Outer races of inside and outside bearings not shown in Figure B)

Disassembly

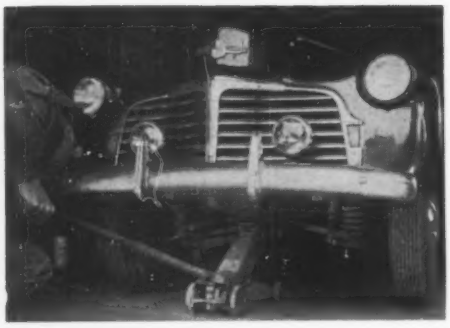

Figure 1

1. Raise one or both front wheels enough to clear the floor

(Make sure vehicle is secure on jack or lift before starting disassembly). See Figure 1.

2. Optional Step

(Not applicable on some models). Drive wooden wedge between steering knuckle support and spindle body. (This eliminates all play except that in bearing assembly).

3. Check wheel for play and freedom of rotation

(Grasp tire tread as shown in Figure 3). Alternately push with one hand and pull with the other to determine looseness. Excess play indicates too loose adjustment, or worn or broken bearings. Turn wheel to check freedom of rotation. Drag indicates brakes holding, too tight bearing adjustment or defective bearing. Rattling sound may indicate broken bearing. Note any abnormal conditions for further reference.

Figure 3

4. Place clean wiping cloths on clean area of workbench on which to place parts as they are removed

5. Remove hub cap and place on cloth with bright side down

Hold cap so that it will not fall on floor and be marred or dented.

Note: Remove and service only one wheel at a time to avoid mixing the parts from the two wheels. (Insert screwdriver or hub cap remover between flanges of hub cap and wheel. Turn screwdriver blade enought to pry off cap. Never attempt to drive cap off as it may be damaged. Be careful not to mar wheel finish). See Figure 5.

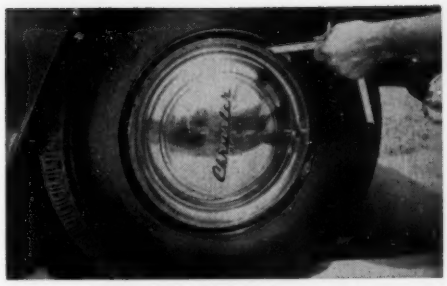

Figure 5

6. Remove inner dust cap

(Pry off by tapping screwdriver with light hammer or use special dust cap tool). See Figure 6.

Figure 6

7. Remove cotter pin and discard

See Figure 7. (Straighten ends and remove with pliers or cotter pin puller. Always throw used cotter pins away).

8. Remove spindle nut and washer

See Figure 8.

Note: Left hand thread (counter-clockwise) is used on left side of some cars.

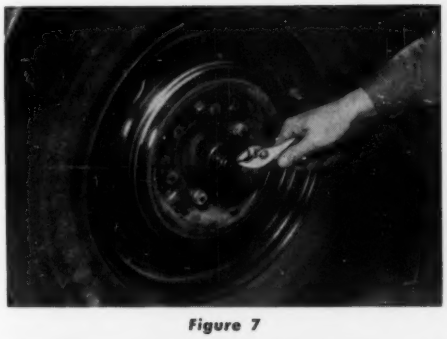

Figure 7

9. Jiggle wheel slightly to loosen outside bearing, then take out freed bearing parts and place on clean cloth

Optional Alternate: Replace dust cap, (lightly—just enough so it won't fall off. This prevents bearings from falling onto floor). See Figure 9.

10. Remove wheel carefully

(Do not drag wheel off spindle. Lift slightly and pull toward you keeping wheel centered with spindle to help prevent damage to grease retainer. On cars or trucks with heavy wheels removal of wheel from brake drum or hub will make hub removal easier and will help prevent damage to retainer). **Note:** If wheel cannot be pulled out due to tight brakes (a) turn wheel while pulling or (b) work brake pedal up and down vigorously, this may loosen brakes sufficiently or (c) if these methods fail, brake adjustment will have to be loosened.

Figure 8

11. (Use this step if Alternate 9 is used, otherwise disregard this step).

Remove dust cap, washer and cone of roller bearing, or inner race and ball assembly of ball bearing

(If retaining washer is used, pry off with screwdriver). Place parts on cloth.

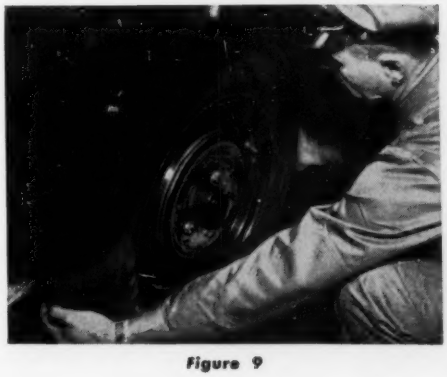

Figure 9

Cleaning

Figure 12

12. Clean brake drum

(Use clean, dry bristle brush to remove dust and dirt from brake drum. Remove any excess grease from drum). Place wheel with brake drum over cloth on floor, inner bearing side down. See Figure 12.

Figure 13

13. Brush dust out of brake shoe area

(Protect spindle with cloth during this step). See Figure 13.

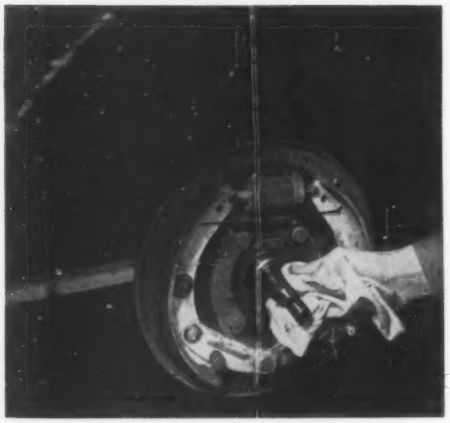

Figure 14

14. Wipe spindle clean

(Use clean wiping cloth to remove old lubricant). See Figure 14.

15. Where ball bearings are used, remove inner race of inside bearing from spindle; also remove dust shield if used

Figure 16

16. Remove inside bearing and grease retainer from wheel

See Figure 16. (Insert a brass drift or a short length of broomstick through small bearing end of hub until it rests against inside bearing assembly. Tap end of stick gently with a soft mallet while moving other end around bearing assembly. Do this until grease retainer is loose in hub. Remove grease retainer and inside bearing assembly, and place on cloth).

17. (Optional)

Remove all lubricant from hub and wipe clean

See Figure 17.

Figure 17

18. Clean both inside and outside bearing cups, or outer races of ball bearings

See Figure 18. (Use a clean cloth dipped in Stoddard solvent or kerosene and wipe dry).

Figure 18

19. Clean bearings, washer and spindle nut

The use of a "bearing washer" is preferable since it forces solvent through the inside of the bearing cage. See Figure 19. (If a bearing washer is not available, wash units separately in container of clean Stoddard solvent or kerosene. Use of a small brush with no loose bristles will be helpful).

Figure 19

20. Clean grease retainer

(Use clean cloth only. Do not wash leather or felt seals in solvent).

21. Dry bearings thoroughly

See Figure 21. (Lubricant will not stick to wet or oily surfaces. Lubricate bearing immediately to prevent rust). **Caution:** Do not spin balls or rollers by air pressure as it will ruin bearings. **The air supply should be clean and dry.**

Figure 21

Figure 22

Inspection

22. Inspect cups and cones of roller bearings, races and ball assemblies of ball bearings, and grease retainers

See Figure 22. (Inspect carefully for pitting, scratches, excessive wear or other damage. Light blue or straw discoloration of ball bearings does not indicate bearing failure).

23. If either cups, cones, ball assemblies or races are worn, pitted, scratched or indented, replace entire bearing assembly

(Remove outer races or cups in the same way as inner bearing was removed—See Step 16).
Warning: If a new bearing is needed, install a new assembly. Never replace only a part of a bearing assembly as premature failure of bearing may result.

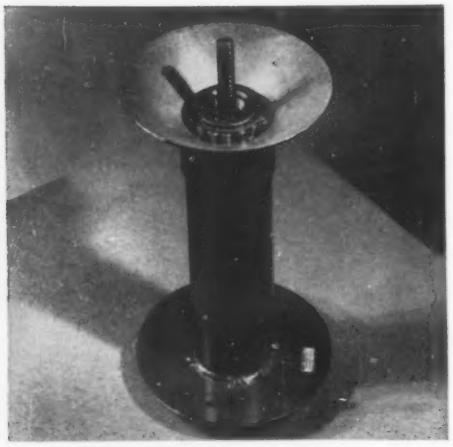

Figure 25

24. Replace damaged or worn grease retainer

In any case, the best and safest practice is to install new grease retainers.

Lubrication

25. To lubricate bearings, use a bearing packer to be sure lubricant reaches all bearing surfaces

See Figure 25.
Note: Hand packing of bearings is not recommended because of the difficulty of **completely** filling the inside bearing spaces with grease and the greater possibility of contaminating the grease with dirt. Roller bearings are particularly difficult to pack by hand since **all the space inside the bearing cage must be filled with grease,** by working the grease into one end of the cage until it oozes out at the other end. **Inadequately packed bearings may fail prematurely.**

Figure 26

26. Follow equipment manufacturer's instructions for use of bearing packer

Figure 26 shows a roller bearing cone in place on a wheel bearing packer.

27. Force sufficient grease into bearings to flush out any trace of old lubricant or cleaning solvent

See Figure 27.

Figure 27

28. Remove bearings from packer

29. After packing bearing, lightly coat all surfaces of assembly with grease

(Not too much grease—just enough to cover). See Figure 29.

Figure 29

30. Coat spindle and inside of hub with a thin layer of grease to prevent rusting

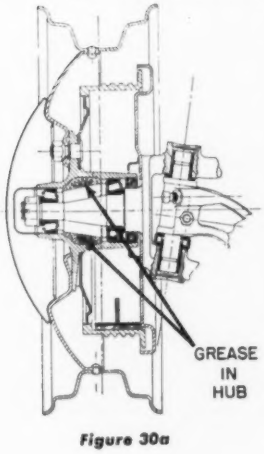

Figure 30a

See Figure 30.

Caution: The hub should **not** be packed with grease but, for roller bearings only, a leading roller bearing manufacturer recommends filling the hub cavity to the inside diameter of the cups as shown in Figure 30a.

A large excess of grease increases temperatures, may cause leakage onto brakes, and can do no lubricating anyway.

Figure 30

Figure 33

Reassembly

31. Where ball bearings are used, install dust shield and inner race of inside bearing on spindle

(For better protection of grease retainer, some car manufacturers recommend placing inner race of inside ball bearing **in the ball assembly** before hub is replaced on spindle).

32.(a) If inside and/or outside bearings are replaced, the cups or outer races should be pressed into the hub by means of an arbor press

If press is not available, they may be tapped into place with a soft hammer and a brass drift. The use of a clean piece of pipe (slightly smaller in diameter than the outside of the cups or outer races, and with the end out of square) in place of a drift will tend to eliminate cocking or distortion during seating in hub.

Figure 35

32.(b) Before installation of grease retainer, distribute a thin layer of grease on inner and outer edges

33. Install cone of inside roller bearing or ball assembly of ball bearing and grease retainer in hub

Tap retainer in straight using a soft hammer. See Figure 33.

34. Replace hub on spindle

(Support weight of wheel and keep centered. Be careful not to damage grease retainer or spindle threads).

35. Replace outside cone of roller bearing, inner race and ball assembly of ball bearing, washer and spindle nut

(Tighten nut with fingers). See Figure 35.

Figure 36

Adjusting

36. Bearing adjustment

(If wheel was removed from drum on disassembly, replace wheel on drum before adjusting bearings).
A. Rotate wheel and tighten nut until it binds slightly. See Figure 36. (Use a wrench not longer than 8 inches or grasp larger wrench close to spindle nut. With wheel rotating, tighten nut until a slight bind is felt. This slight bind means that all

surfaces are in contact). Back off the nut one flat (60 degrees, or less) and check for wheel play. If no rock or play is felt, insert new cotter pin, having essentially same diameter as hole in spindle, in slot nearest cotter pin hole. If rock or play is felt, tighten nut slightly until another cotter pin slot of nut lines up with cotter pin hole in spindle, then insert cotter pin, making sure head fits down into castellation of nut. When adjustment is completed, turn wheel to check for freedom of rotation. **Note:** Do not mistake looseness in the king pins for loose bearings. If the king pins are loose, the wheel will shake with the bearings drawn tight.

B. Where torque wrench is used for adjusting bearings, follow vehicle manufacturer's recommendation.

Completion of Reassembly

37. Bend cotter pin in locked position

(Always use new cotter pin—pins are cheaper than accidents. Bend one leg toward end of spindle. Cut off and bend other leg back over nut). See Figure 37. **Note:** If radio static suppressor is used in dust cap, cut off one end of cotter pin so that it does **not** cover cone-shaped hole in end of spindle. Clean inside of dust cap, contact on end of suppressor and end of spindle to insure good contact.

Figure 37

38. Replace dust cap

Never hit cap in center. Use special tool (illustrated) for this purpose, or screwdriver and light hammer and tap against flange on cap. See Figure 38.

39. Clean and replace hub caps

(Make sure no sand or gravel is trapped in cap. Never hit hub cap in center. Place hands on edges and press cap into place. Wipe off dirt and finger marks.)

Figure 38

40. (If Optional Step 2 is used)
Remove wood wedge between steering knuckle support and spindle body

41. Repeat process on other front wheel

42. Remove jack or lower lift and check off service order

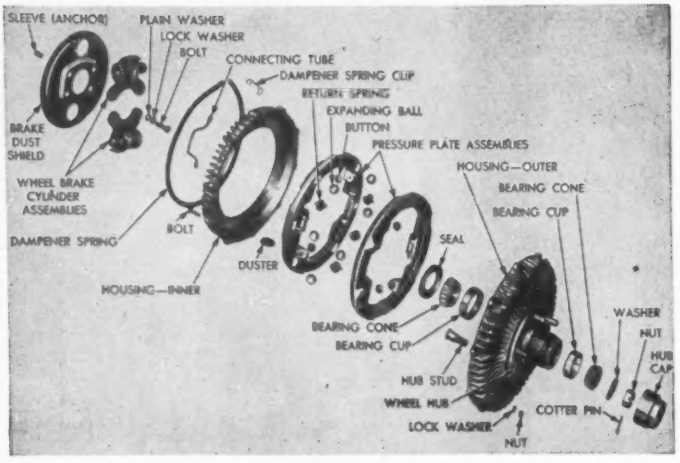

Figure C

Wheels with Disc Brakes

Certain Chrysler models produced since 1949 are equipped with disc brakes. On wheels, with brakes of this type, it is necessary to separate the inner and outer brake housings for access to the wheel bearings. Proper procedure for servicing wheel bearings on wheels with brakes of this type follows: See Figure C.

Figure 44

43. Remove tire and wheel assembly from brake housing in usual manner

44. Remove dampener springs and dampener spring clips as shown in Figure 44.

Care should be taken not to lose dampener spring clips.

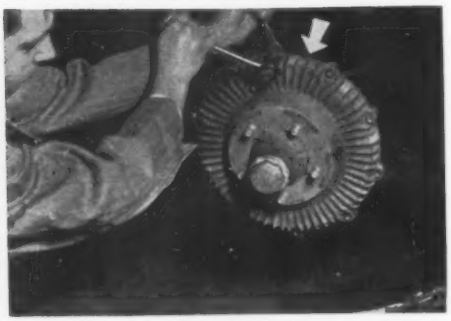

Figure 45

45. Remove housing attaching bolts around the outside of the brake housing

Inner and outer housings are matched sets. Cut-outs cast in each housing (See arrow, Figure 45) should be mated on reassembly. It is good practice to mark the housings carefully with chalk or paint so the two halves can be reassembled in the proper position.

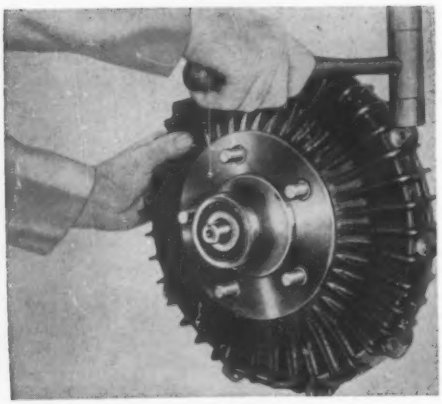

Figure 47

46. Remove dust cap, cotter pin, nut and washer (See steps 6 through 8).

47. Separate inner and outer housings by tapping lightly at one of the attaching bolt hole flanges with a soft hammer

See Figure 47. (When housings begin to separate, remove cone of outside bearing, using care to avoid damage to the bearing).

48. Clean, inspect and re-lubricate bearing assemblies, hub and spindle

(See steps 12 through 34).

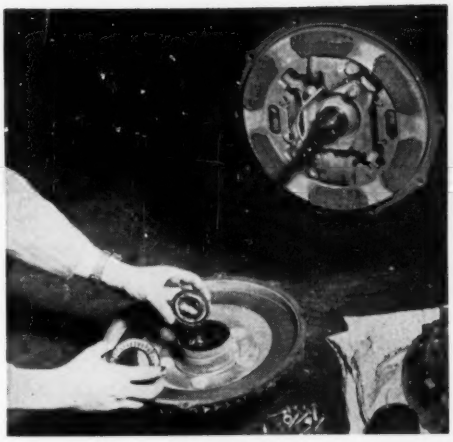

Figure 49

49. Reassemble inside bearing, hub and outer brake housing

See Figure 49. (Inner and outer housings must be properly mated).

50. Install cone of outside wheel bearing, washer and nut

Adjust bearing, install new cotter pin and replace dust cap.

Figure 51

51. Install the housing bolts, lock washers and nuts

See Figure 51.

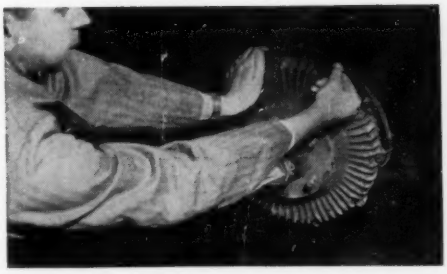

Figure 52

52. Install dampener spring and dampener spring clips

See Figure 52.

53. Replace wheel and tire assembly

See Figure 53.

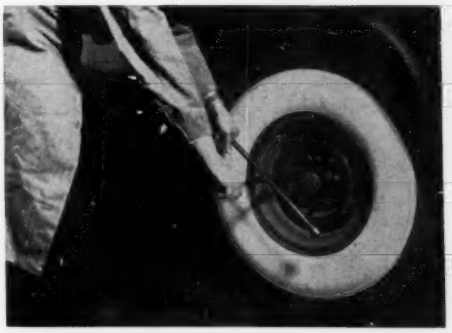

Figure 53

54. Repeat process on other front wheel

55. Remove jack or lower lift and check off service order

ESTABLISHED 1933

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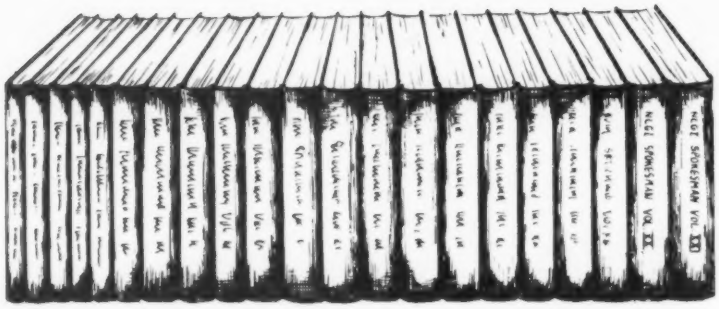

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Letter to the Editor—

"Now . . . Sell Chassis Grease!"

January 29, 1958

"Gentlemen:

"Here is an idea on how we in the grease industry could create more sales for chassis grease and at the same time increase motor oil sales. If you will pardon me, I will back into my idea by starting with motor oil.

"It appears the motor oil business has two strikes against it—(1) the high quality lube oil claims by oil companies, and (2) the reducing crank case capacity designed by the motor car manufacturers.

"Now let's analyze this. How can any oil company claim high quality, all season, high and low temperature oil and even hope that the motorist will change his oil every 1,000 miles. After all, the average motorist is a very intelligent person. He reads and listens to advertising claims made for the various motor oils which, by inference in the advertising, suggest oil will operate in the winter, summer, spring and fall. So he thinks to himself, why should I change my motor oil so often? The manufacturer says it's good in the winter as well as the summer. This thinking is obviously happening because the national average for distance between lube oil changes has continuously grown to a new high of 2,388 miles. The crank case capacity is a technical fact beyond the control of the oil industry and something we have to live with like the weather.

"Let's look at it from another angle. We all agree that once a motorist has his car on the lift he will most always have the oil changed, chassis greased, transmission checked, etc. Let's face the facts and admit that we can't get him for more oil changes without double talk. Let's sell something else—chassis grease! Now here is a product that is underplayed. Why? In the past it was easier to sell motor oil because of all the technical and additive claims. It was a good way, but with progress, changes have to be considered.

"Let's analyze how we can get more motorists on the grease rack by 'hard selling' chassis grease. What is the function of a chassis grease? To prevent metal to metal contact of rubbing chassis parts. This prevents wear and noise on such vital parts as steering linkage, suspension points, shackle pins, etc. Wear and noise is something the average motorist understands. Wear can be further exploited to satisfy a point the motorist appreciates—personal safety, safety of his family, etc. Consider a recent statement attributed to the officials of the New York State Thruway. 'A high percentage of the wrecks on this thruway are caused by malfunctioning of worn parts.' Happening at high speeds this causes wrecks and loss of life. Malfunctioning caused by wear could be reduced by more frequent greasing of cars. Not only the lubricated parts are subject to inspection, but vital parts such as brake cylinders, brake cables, steering boxes, steering linkage, hydraulic lines, suspension points, etc., can be checked while the car is being greased. Every motorist could be educated for personal safety reasons to have his car put on the lift for a grease job and safety inspection before every long trip. More frequent greasings will prevent wear, noise, and provide the opportunity to inspect the mechanical condition of the car for safe driving.

"Now I realize some advertising or financial people will say that there is not sufficient profit selling grease in comparison to oil or gasoline to justify advertising and promotion. Let's not forget the function of advertising is to get customers and prospects into the station, and the source of revenue on each product should not dictate which products should be advertised. Any time you can convert product technology and functioning down to the motorist's language like you can with chassis grease (noise, wear, etc.) you are on firmer ground than talking about something he can't understand, such as octane, viscosity index, pour points, etc.

"This is only an idea, but I am sure with some positive thinking or 'brainstorming' on this subject any major oil company and its advertising agency could create a hard-hitting campaign to sell more chassis grease jobs, and with this more motor oil. In both cases you will be selling and consuming more oil, thus increasing the demand we have already created. Let us remember, 'there is more than one way to skin a cat.'

Yours very truly,
(Signed) E. E. Smith, Manager
Chemical Sales"

E. E. Smith is Climax Molybdenum's manager of lubricant development and that organization's NLGI Company Representative. Long associated with the petroleum industry before joining Climax, he is also a previous technical contributor to the NLGI Spokesman.

Patents and Developments

Greases Containing Polyethylene

U. S. Patent 2,810,695 issued to D. W. Young, A. J. Morway, and A. F. Sayko, assigned to Esso Research and Engineering Company. Greases capable of withstanding high rates of shear and having outstanding structural stability are produced with a mixture of about 15-25 per cent linear, toluene-soluble polyethylene and about 75-85 per cent of cross-linked toluene-insoluble polyethylene as major components of the thickener. The linear polymer should have molecular weights in the range of 18,000-25,000 Staudinger. Both types are first milled together on a roller mill and added to the lubricating oil in the amount of 5-10 per cent by weight. Grease-forming soaps also may be added.

Lithium Base Grease Containing Rust and Copper Corrosion Inhibitors

U. S. Patent 2,812,306 issued to H. J. Liehe, assigned to Standard Oil Company (Indiana). Corrosion-resistant greases for use at −65° to 250°F. are prepared from the following compositions: Lithium soap of high molecular weight carboxylic acid 5-20 per cent, sperm oil 0.5-3 per cent, petroleum oxidation product 0.5-3 per cent, oil-soluble polyvalent salt of dialkyl dithiocarbamic acid 0.5-0.5 per cent, metal deactivator 0.05-0.25 per cent, and remainder, synthetic lubricating oil. The petroleum oxidation product is a mixture of oxygenated compounds obtained by the controlled oxidation of hydrocarbons, and is a mixture of aliphatic alcohols, ketones, alcohol-ketones, lactones and esters, together with unoxidized hydrocarbons. Suitable products are sold by Alox Corporation under the trade name of "Alox" compounds, the preferred product being "Alox 125." The dithiocarbamic salt may be zinc diamyl dithiocarbamate, zinc dioctyl dithiocarbamate, chromium octyllauryl dithiocarbamate, etc. The metal diactivator is a reaction product of an aromatic ortho-hydroxy aldehyde such as 2-hydroxy benzaldehyde or salicylaldehyde and an alkylene polyamine, such as di(2-hydroxybenzol)-alkylene-polyamines. The synthetic oil is a dialiphatic ester of dibasic carboxylic acid, such as di-(2-ethylhexyl)-adipate.

Light Colored Fatty Acids

U. S. Patent 2,812,343 issued to

R. P. Cox and R. M. Brice, assigned to Archer-Daniels-Midland Co. Stable light-colored fatty acids of 1.5-6 Gardner 1933 (when freshly distilled) by treating an acidulated, washed, autoclaved and dried soapstock with 1-5 per cent of concentrated phosphoric or sulfuric acid by gradually adding the acid to an agitated mass of the soapstock at about 32°C., maintaining the acidulated soapstock in an agitated condition at about 32°C. for a period of time after acid addition has been completed, allowing the mass to stand for a substantial period of time at about 38°C., removing the clear oil from the sludge, washing to remove water-soluble acidulation products, and then distilling off the fatty acids. Acids prepared in this manner have a residual nitrogen content of only 0.45-0.90 mg. per 100 gms., so that over 70 per cent of the nitrogen present in the autoclave split stock is removed, the latter believed to be responsible for the color of the acid.

Grease Compositions Stabilized with Azines

Patent No. 2,813,112 issued to V. C. Fusco and R. C. Harshman, assigned to Olin Mathieson Chemical Corporation. Fatty soap compositions such as greases are stabilized against oxidation by incorporation therein of 0.05 to 1 per cent of an azine, such as dimethylketazine, salicylalazine, cinnamalazine, etc.

News Items

The new Shell Aivania greases based on lithium 12-hydroxystearate contain a new powerful corrosion inhibitor. Oxidation stability, under working and static storage conditions, reportedly was improved considerably (*Chem. Trade* J. 8/30/57, p. 299).

Gulf Oil's plastic Petroleum-B thixotropic grease is successfully lubricating business machines from the Arctic to the tropics, according to Cash Register. The grease becomes thin and oily when worked and, when not worked, turns back to a light grease (N. Y. *Times*, 11/9/57, p. 31).

People in the Industry

Dickason Elected Jesco Vice President

Joseph J. Dickason has been elected to the position of vice-president, research and development, of the Jesco Lubricants company, it was announced by Claude L. Johnson, president.

Dickason has been associated with the North Kansas City manufacturer of lubricating greases for seventeen years, beginning as a chemist and serving as chief chemist since 1945.

A graduate of the University of Kansas in 1940, he has been active in and held committee appointments in the American Society of Testing Materials, the American Chemical Society and the National Lubricating Grease Institute. Currently, Dickason is chairman of the NLGI technical sub-committee on classification of lubricating greases and a member of the steering committee of the NLGI Technical Committee.

Thomas to Head Battelle Memorial Institute

The board of trustees of the Battelle Memorial Institute, Columbus, Ohio, has announced the election of Dr. B. D. Thomas as president.

A member of the Institute's executive and technical staff since 1934, Dr. Thomas was appointed assistant director in 1942. Subsequently, he was named secretary of the Battelle Memorial Institute corporation and in July, 1955, he became a vice-president. In December of 1956 he was appointed director of the Institute.

Dr. Thomas' varied scientific interests are reflected in various papers in physical chemistry, oceanography, ore dressing and research management.

He established and headed Battelle's first division of chemical research in 1939 and assisted in the establishment of Battelle's research laboratories in Frankfurt, Germany and Geneva, Switzerland.

Walsh Succeeds Gildersleeve

John J. Walsh has been elected vice-president of Penola Oil company, a marketing affiliate of Esso

Standard Oil company, it was announced last month.

He succeeds Stanley P. Gildersleeve, who moved up to the presidency of Penola with the retirement of Clarence M. Davison. Mr. Davison had 46 years' service with Penola, Esso Standard and Standard Oil company (N.J.), Esso's parent company.

24-Year Veteran

Mr. Walsh joined the New York sales organization of Esso Standard in 1934 and became a lubricating-oil specialist only three years later. He has been with Penola since 1946 and has been manager of the company's wholesale lubricating oil department for the last six years.

Penola markets lubricating oils, waxes and greases and other petroleum specialty products, both in this country and overseas.

Named Director of Girdler Catalyst Research

Dr. John N. Pattison has been appointed director of research and development for Girdler catalysts in the chemical products division of National Cylinder Gas company.

Walter H. Girdler, Jr., president of the chemical products division, said Dr. Pattison would make his headquarters in Louisville where he would be in charge of specialty catalyst studies for the petroleum, gas chemicals, synthetic rubber and related industries.

The firm has been a major supplier of specialty catalysts for the past fifteen years.

Dr. Pattison was formerly head of the catalyst research section of the Cities Service Research and Development company, Lake Charles, La., where he organized that firm's research section which engaged in the development of new catalytic refining processes and the improvement of existing ones.

From 1948 to 1956 he was assistant chief of the chemical research division of the Battelle Memorial Institute in Columbus, Ohio, where he headed research on industrial applications of catalysts and conducted scientific studies on lubricants, cosmetics and other phases of surface chemistry.

He headed the catalyst department of the Koppers Co., Inc., Kohuta, Pa., from 1942 to 1946 and engaged in research related to the production of butadiene and styrene as part of the World War II synthetic rubber program.

Dr. Pattison holds a BS degree in chemistry from West Virginia university and a PhD. in organic chemistry from Purdue university. He served as a fellowship assistant in chemistry at the Mellon Institute of Industrial Research in Pittsburgh in 1942 and was a research fellow at Purdue from 1946 to 1948.

He is a member of the American Chemical Society and is a member of the program committee of the International Congress on Catalysis. He also holds membership in Sigma Pi Sigma, honorary physics fraternity, and Sigma Xi, science honorary.

To Address Georgia Oil Jobbers

Charles E. (Chuck) Gore, sales manager, lubricants division, Battenfeld Grease & Oil Corp., will address the annual meeting of the Georgia Oil Jobbers association. The meeting will be held at the King and Prince hotel, St. Simons Island, Georgia, on May 2 and 3.

Gore's talk will be on sales problems affecting the oil jobber in today's highly competitive lubricants market.

Gore is quite active in the marketing area of the oil industry. He has contributed several papers on marketing and has appeared on the national program of NLGI and the Independent Oil Compounders of America. In addition he has acted as sales consultant to such widely varying industries as the Dental Dealers of America and The National Auto Parts association.

Two of his most recent papers, "Selling Customer Benefits" and "A Return to Fundamentals" have excited a good deal of industry interest.

Amalie Appoints J. J. Brown to the Baltimore District

Appointment of John J. Brown as the Baltimore, Md., district manager for the sale of Amalie oils and lubricants was announced by C. H. Remmel, general sales manager, Amalie division, L. Sonneborn Sons, Inc., Franklin, Pa.

Brown will direct Amalie sales in Maryland, District of Columbia, North and South Carolina, Virginia and eastern Pennyslvania.

He moves to the Baltimore job after representing Amalie for the past five years in the Boston and New England area. Brown has been in the automotive business for the past 20 years, with the Alemite company and as district manager for the Calso organization.

New Staff Product Application Engineers Appointed by Gulf Research & Development

Mr. W. J. Brown and Mr. H. H. Donaldson, Jr., have been appointed staff product application engineers in the marketing technical service division of the Gulf Re-

search & Development company, research subsidiary of the Gulf Oil corporation.

In his position, Mr. Brown will be handling all steel plant technical service activities; Mr. Donaldson will be responsible for the coordination of technical service activities pertaining to trucks and buses and fleet operations.

A graduate of the Brown school of petroleum, Marietta college, Marietta, Ohio in 1950, Mr. Brown was formerly the lubrication engineer of American steel and wire division, U. S. Steel corporation, Cleveland, Ohio.

He has wide experience in steel mill lubrication, product evaluation and roll oils for stainless steel and high carbon strip steel.

Following his graduation from Lehigh university in 1939 with a B.S. degree in Chemical Engineering, Mr. Donaldson joined the process section, chemistry division of Gulf research. In 1941, he was transferred to the product development section as group leader working on automotive lubricating oils.

From 1946 to 1950 he was head of the automotive lubrication section of the engineering division. In that latter year, he was transferred to the product development and product engineering unit of Gulf's domestic marketing department, where he handled technical matters pertaining to the company's marine products.

Since 1954, Mr. Donaldson has been attached to Gulf's Toledo sales division where he has represented general office, product application in maintaining their technical activities with the automotive industry.

Both men will be headquartered at the research center at Harmarville, Pennsylvania.

Personnel Announced at American Potash South-Central Office

American Potash & Chemical corporation has opened a south-central district sales office at Shreveport, La., to handle the company's expanding interests in the states of Louisiana and Mississippi and parts of Alabama, Texas, Oklahoma and Arkansas.

William W. Young, southern area sales representative with the company since 1949, has been named district sales manager of the branch, located at 1600 Fairfield Ave., Shreveport.

Niven D. Morgan has joined the company as sales representative to operate out of the Shreveport office. Morgan has been in farm management work since he was graduated from Southwestern Louisiana Institute in 1952.

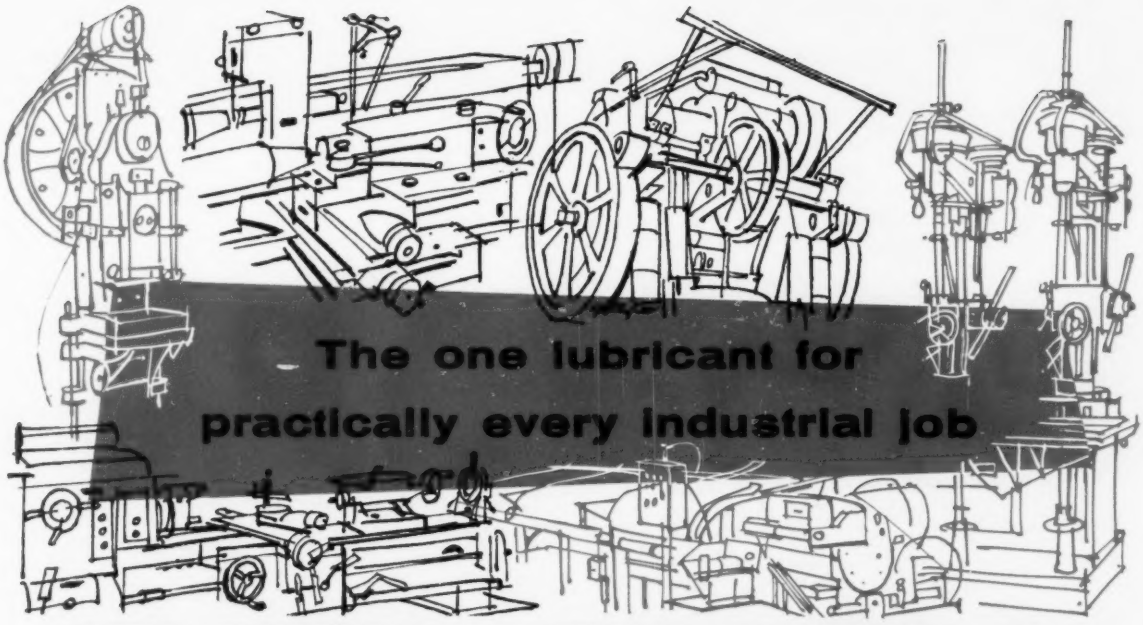
Announcement of the new offices was made jointly by A. J. Dirksen, AP&CC general sales manager of the industrial chemicals division, and E. M. Kolb, general sales manager of the heavy chemicals division from AP&CC's eastern headquarters in New York City.

Doyle Becomes Branded Marketing Vice President For Kerr-McGee Oil

W. H. Doyle has joined the company as vice-president in charge of branded marketing, for Kerr-McGee.

Until recently manager of the Cleveland, Ohio, sales division of Standard Oil company of Ohio, Mr. Doyle joined that company in 1930 as a service station operator. He later became a general salesman, terminal superintendent, district manager and division manager.

Mr. Doyle is a native of Dayton, Ohio. He attended Findlay, Ohio, schools, and studied at Harvard and Stanford graduate schools of business. His service with Standard of Ohio was interrupted by two tours of active duty with the U. S. Air Force, during World War II in the European theater, and in the Korean War.



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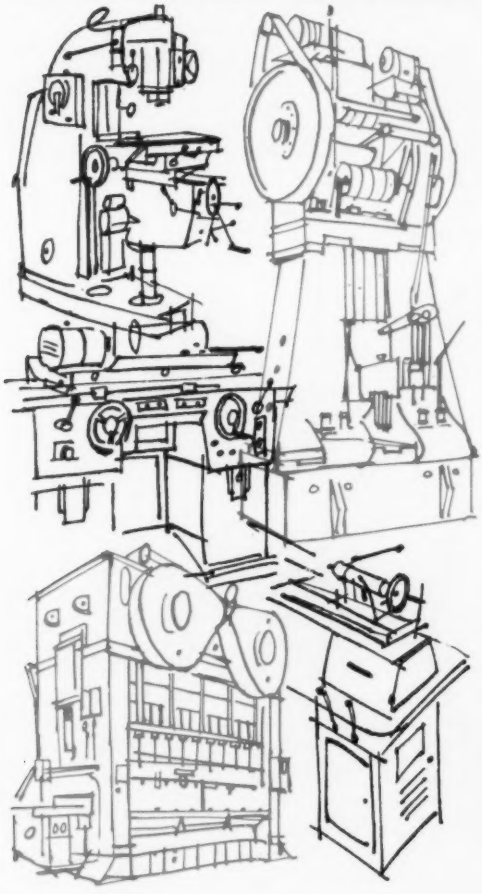

Atlantic Lubricant 54—an outstanding multi-purpose lubricant—assures:

- **Wider application**—almost universal application to grease-lubricated equipment in plants of all sizes
- **Excellent performance** at very high to extremely low operating temperatures
- **Reduced losses** from lubricating error
- **Lower costs** of warehousing and handling
- **Outstanding rust protection** for all ferrous surfaces
- **Unusual stability** against oxidation and softening—even under very rugged conditions
- **Easy, positive identification**—thanks to Atlantic Lubricant 54's distinctive purple color

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In South America
Atlantic Refining Company of Brazil, Rio de Janeiro

Tucker Takes Emery Ohio Area

Malcolm R. Tucker has been appointed fatty acid sales representative by Emery Industries, Inc., for the Cincinnati territory, G. W. Boyd, sales manager of the Fatty Acid Sales department, announced today.

Mr. Tucker will be responsible for the sale of Emery's complete line of fatty acids in the territory comprising all of Ohio except the northeast section, West Virginia, eastern Indiana and Kentucky, and southwestern Michigan. The products include Emery's stearic and oleic acids, hydrogenated fatty acids and glycerides, animal and vegetable fatty acids, and castor oil derivatives.

Tucker, a veteran of ten years with Emery Industries, was a supervisor in the production department prior to his appointment. He is a graduate of Wilmington college, Wilmington, Ohio, and attended the University of Cincinnati and the University of Dayton.

Sales Manager Named For Girdler Catalysts

John W. Benedict has been appointed sales manager for Girdler catalysts in the chemical products division of National Cylinder Gas company.

Howard C. Hartough, general manager of Girdler catalysts, said Benedict would make his headquarters in Louisville where he would have charge of an expanded sales program in the field of specialty catalysts to the chemical, plastics, petroleum, food and other industries.

For the past seven years Benedict has held various sales assignments with the petroleum catalyst department of Davison Chemical company, a division of W. R. Grace & company. Since 1956 he has been district sales manager in that firm's New York office with responsibility for sales in the east coast, Caribbean and export markets. He previously was in charge of catalyst sales west of the Mississippi river from the district sales headquarters which he established in Houston, Tex., in 1954.

He is a native of Holden, Mass., and holds a BS degree in chemical engineering from Worcester Polytechnic Institute and an MS degree in the same field from Northwestern University.

American Potash Officers

Frederick Marsic has been elected secretary of American Potash & Chemical corporation and Henry DeArmond assistant secretary, according to an announcement by Peter Colefax, president. The officers were named following the election of Richard J. Hefler, formerly company secretary and assistant to the president, as vice president in charge of finance.

Marsic, formerly assistant secretary, retains his other positions as assistant treasurer and office manager at company headquarters at Los Angeles. DeArmond was administrative assistant prior to his present appointment.

Marsic is the longest service employee of American Potash, having been with the company nearly 45 years. He joined the company in 1913 as an office boy at AP&CC headquarters, then in New York. After being promoted to chief accountant, he was named assistant secretary and assistant treasurer in 1942. In 1946, when the company moved headquarters to Los Angeles, Marsic was transferred to California and was named office manager of the main office.

Cuts cooling cycle 3 hours at Socony Mobil

Continuous grease-cooling with VOTATOR* Heat Transfer Apparatus at Socony Mobil Oil Company, Inc., New York, is producing these benefits compared to batch method:

- Product uniformity—more easily obtained with automatic, controlled cooling.
- Saving of 3 hours in cooling time—with more rapid heat transfer rates.
- Simplified housekeeping—with fully enclosed cooling, compact installation.
- Sustained operation—because VOTATOR is designed and built to handle round-the-clock processing . . . give you high output, long trouble-free service.

Find out how *you* can benefit with VOTATOR Grease Processing Apparatus. Call or write for complete information.

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Industry News

ASTM Standards on Petroleum Products and Lubricants (D-2)

1137 pages, heavy paper cover, 6x9, $8.00

This compact volume contains most of the ASTM standards pertaining to petroleum products and lubricants, with 188 distinct standards of which 43 are new, recently revised, or have had their status changed. Designed for ready reference, this volume has proved its value over the years as revised editions have appeared.

Among the major topics covered are measuring and sampling, crude petroleum, natural gases, butadiene, motor and aviation fuels with related test methods, petroleum lubricants aromatic hydrocarbons, diesel fuels, lubricating oils, industrial oils, and turbine oils. In addition, standards on petroleum waxes, spray oils, insulating oils, greases and graphite, antifreezes, bituminous materials, and coke are also included.

There are extensive appendices, tables, and charts which make this book extremely useful, particularly in the laboratory. Presented for information only are thirteen proposed methods of test. These have been included in draft form to solicit comments.

Copies of this compilation may be obtained from the American Society for Testing Materials 1916 Race Street, Philadelphia, Pa., at $8.00 per copy.

LCA to Join MCA

Application for membership in the Manufacturing Chemists' association is being made by Lithium Corporation of America, according to Marshall Sittig, managing director of the American Lithium Institute. The two other institute members, American Potash and Chemical corporation and Foote Mineral company, are already MCA members—and the three companies will affiliate with MCA's newly formed reactive metals activity.

"The interests of our member companies extend beyond Lithium itself," Sittig said, "and we feel that these interests can be served by the broader scope of MCA's over-all program."

Gulf to Build Alkylation Plant at Toledo Refinery

Gulf Oil corporation announced plans to build an alkylation plant at its Toledo, Ohio, Refinery. The new facilities will combine light hydrocarbons produced in other refinery operations, to produce ap-

proximately 2,000 barrels per day of the high octane blending stock known as "alkylate." This product will be used in Gulf's continuing program of marketing highest quality premium gasolines.

The Toledo unit will be Gulf's fifth alkylation plant. The new plant will consist of a reactor section and four fractionating towers, the highest of which will be 140 feet. It will use sulfuric acid as a catalyst to promote the alkylation reaction.

The M. W. Kellogg company has been named as the contractor to build the new unit. Construction is scheduled to start in the summer of 1958, and operations are expected to begin during 1959.

Hooker, Foote Form New Rocket and Missile Propellant Firm

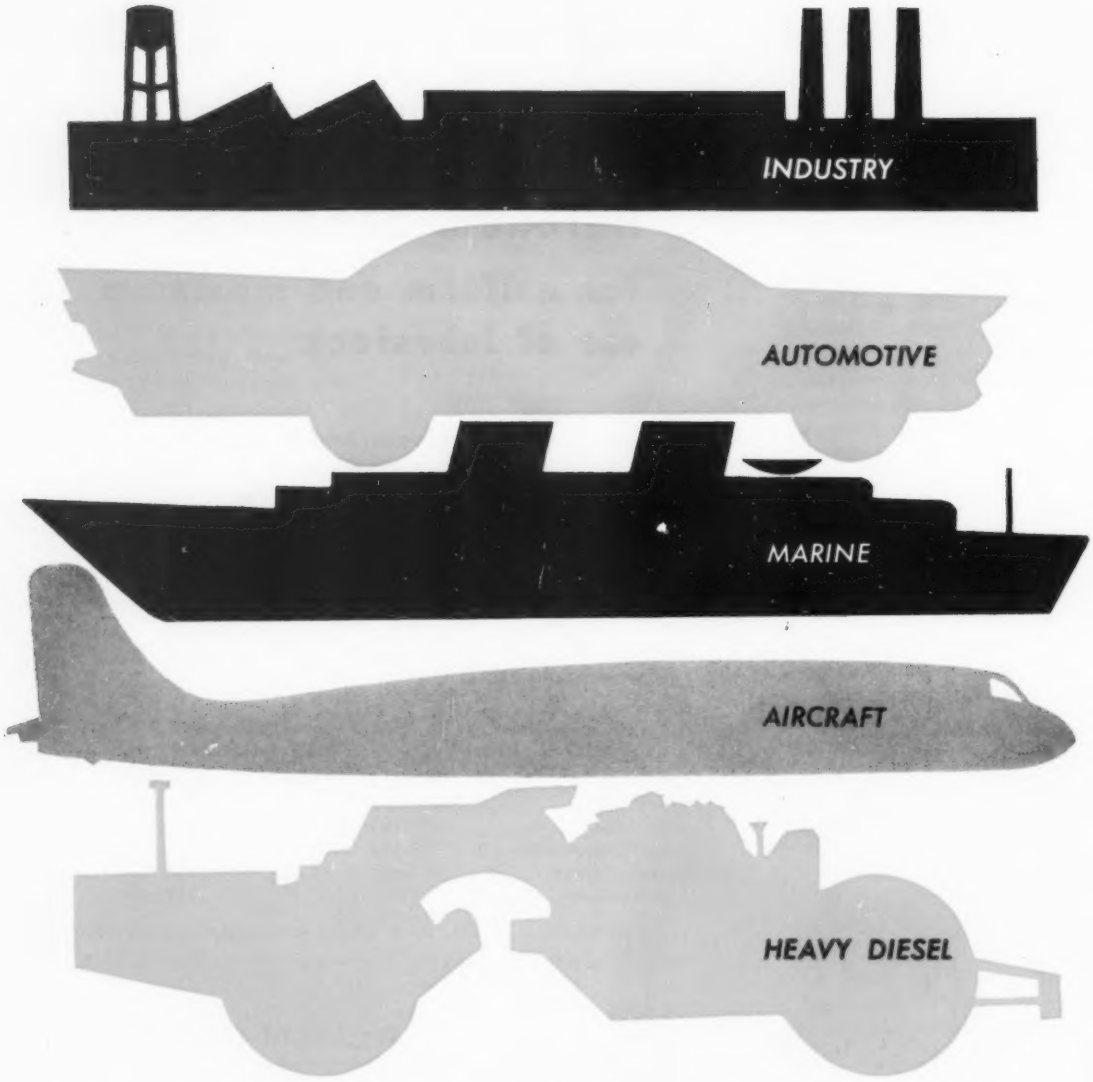
Formation of a new corporation, to be known as HEF, Inc., was announced by Hooker Electrochemical company of Niagara Falls, N. Y., and Foote Mineral company, Philadelphia, Pa. The new firm will specialize in the manufacture of components of solid fuels for rockets and guided missiles, specifically ammonium perchlorate and other perchlorates.

Hooker and Foote have been engaged in a joint study of the propellant market since September of last year, when they announced their intent to work together in a survey of the solid fuel propellants field.

Corrosion Preventive for Reciprocating Engines

The availability of Cosmoline 1090, a corrosion preventive meeting the requirements of Grade I of MIL-C-6529A and MIL-C-006529B (USAF), has been announced by E. F. Houghton & Co., Philadelphia.

The supplier describes the product as a concentrated mix for blend with aircraft symbol engine lube oils. It is added, on a one to three basis, to lube oil in reciprocating engines and equipment for corrosion prevention purposes.



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Medium to high gels...excellent stability...outstanding smoothness...satisfactory color—whatever your grease-making requirements, there's a Witco grease-grade stearate tailor-made for your formulation.

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Specify Witco grease-made stearates on your next order... you can't buy better.

Witco products for the grease industry:

Aluminum Stearates (medium, high and very high gels)

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Lead Stearate	Lithium Hydroxystearate

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Girdler to Build Hydrogen Plant for Boron Fuel

A $3,400,000 contract to design and build hydrogen, nitrogen and carbon dioxide producing and purifying units for the world's largest high-energy fuel plant has been awarded to the Girdler Construction division of National Cylinder Gas company, Chicago.

Callery Chemical company of Pittsburgh, prime contractor for the Navy's $38,000,000 plant now under construction at Muskogee, Okla., said that Girdler Construction, Louisville, Ky., will furnish all engineering, apparatus, material and complete field construction and start-up services for the high-purity industrial gas plants.

The entire Muskogee plant is scheduled for completion at the end of 1958, producing tonnage quantities of the new exotic fuel developed from high-energy boron compounds to power jet aircraft and missiles to new peaks of performance and efficiency.

Giant Size Amalie Drum

Announcement of a 400-pound drum unit of Amalie Black Velvet ball joint suspension grease was made by C. H. Remmel, sales manager, Amalie division, L. Sonneborn Sons, Inc., Franklin, Pa. This is a new addition to sizes heretofore available: 35-pound pails- and 100-pound drums.

Amalie Black Velvet ball joint suspension grease is formulated from a heavy-duty, highly water-resistant chassis lubricant fortified with special load-carrying and corrosion resistant additives. It has unusual tenacity, endurance and strength, Remmel explained, to assure prolonged and effective lubrication of the heavily stressed and loaded bearing surfaces characteristic of all types of ball joint and torsion bar suspensions.

Inquiries concerning this new product should be directed to the Amalie division of L. Conneborn Sons, Inc., at Franklin, Pa.

Pioneer Adds Size "Extra-Large" to Stanzoil Duplex NL-34 Industrial Glove

A new size, extra-large, has just been added to their line of Stanzoil Duplex NL-34 industrial gloves, announces the Pioneer Rubber company of Willard, Ohio. The new glove size, Pioneer officials say, was introduced to meet the growing demands of industry for this lightweight glove, ideal for jobs where prevention of hand fatigue is an important factor.

The sturdy, neoprene-coated outside finish of the Stanzoil NL-34 glove is liquid-tight and at the same time is resistant to the deteriorating effects of oils, acids, caustics, solvents and greases. Pioneer's exclusive non-slip grip holds slippery objects better than bare hands.

Continued from page 56

E. F. Houghton & Co. Opens New Detroit Plant

Completion of new plant and laboratory facilities which will greatly expand its manufacturing potential for the Detroit market, speed up local deliveries and reduce delivered prices is announced by E. F. Houghton & Co.

Construction of the new addition, which more than doubles the plant size, was finished in January by the Sackett company, Inc., Detroit engineers and contractors. New machinery and materials handling equipment have been installed under the direction of Dr. James T. Eaton, Houghton vice-president–production; Herbert Michael, plant engineer; and George P. Wilson, Detroit plant superintendent.

Houghton's original Detroit plant for manufacture of heat treating products and cleaning compounds, was built in 1923. Since the enormous expansion of the automotive and other Detroit industries, many needs for lubricants, metal processing oils and chemicals had to be filled from Houghton plants in Chicago, Cleveland and Philadelphia.

The new plant will supply additive-treated lubricants, cutting fluids of both petroleum and synthetic origins, drawing compounds, fire-resistant hydraulic fluids, rust preventives, heat treating salts, carburizers, hot forging agents and quenching oils. Modern mixing, blending and oil treatment equipment has been installed, and a fully equipped laboratory completed to exercise exacting control over all processing.

The plant is located at Lumpkin Avenue and Detroit Terminal railroad and is served by a freight siding and motor truck lines, assuring prompt deliveries. Twenty-four-hour delivery on standard volume products in the Detroit area is the objective.

New facilities include horizontal and vertical compounding and mixing, stainless steel tanks for chemical processing, and modern control and testing facilities. Special fork truck handling of pallets to a thirteen-foot height to the compounding floor has been planned.

Houghton's Detroit sales division is headed by sales manager Harry E. Martin, with downtown offices in the Stephenson building.

Reynolds Booklet Offer

A basic handbook on industrial applications of aluminum chemicals has been published by Reynolds Metals company.

The 48-page book summarizes the technology of present applications and includes information on sources of aluminum chemicals, major uses, products and quality control facilities. The publication also has tables on technical data.

Technical information on aluminum chemicals covers calcined, fused and activated bauxite; hydrated, calcined, activated and fused aluminas; aluminum powders and pastes, and aluminum drosses.

Copies of the handbook, "Reynolds Aluminum Chemicals" are available to chemists, chemical engineers, purchasing agents and management personnel upon letterhead request to Reynolds Metals company, 2500 So. Third street, Louisville 1, Ky.

Membership Advantages of NLGI

DID YOU KNOW . . .

That the National Lubricating Grease Institute represents over 95% of the lubricating grease industry with members in this country and overseas?

Some of the advantages of membership are listed below:

NLGI has a Technical Committee of 154 members which is divided into nine sub-committees working constantly on industry problems.

Beginning with the production of lubricating grease for the year of 1957, NLGI is instituting a survey which can be of practical value in establishing sales and manufacturing data.

The NLGI SPOKESMAN, a monthly technical journal, is mailed free of charge to key personnel within a member firm. If extra copies of the magazine are needed, they may be purchased at half the regular subscription price.

The Institute works in close cooperation with affiliated groups, including SAE, ASTM, ASA, ASLE, ASME, SAE-CIMTC, and IOCA, on problems and accomplishments in the lubricating field.

The Annual Meeting is the highlight of the year and is usually held during the last week in October. It is a three-day session where papers are presented of unusual interest on technical advances, marketing problems, new developments by suppliers and packagers, and the needs of the consumers. Members of NLGI are allowed a substantial discount on registration fees at this meeting.

Recently NLGI completed production on a new movie entitled "Grease, the Magic Film" which is available at $700 for the first print, $500 for the second print, and $300 for the third and subsequent prints.

Members of NLGI are allowed a $100 discount in each of the above three categories.

The main objectives of the National Lubricating Grease Institute are for the development of better lubricating greases for the consumer and better grease lubrication engineering service to industry.

If your firm is interested in becoming affiliated with NLGI, the national office will be happy to furnish further information concerning the organization. Just as 1957 was a banner year for NLGI accomplishments, 1958 promises to be even better with more scope and more member advantages. ■

NLGI SPOKESMAN

News About NLGI–

Continued from page 5

Production Survey Data—

certified public accounting firm handling the data for NLGI.

Compilation of the statistics is expected to be complete by mid-April. All members of the Institute, in every category, will receive the reports as soon as they have been delivered to the national office.

After delivery has been made to members, interested friends and non-members may obtain copies of the report at a cost of ten dollars per copy. Inquiries may be directed to the national office of the Institute.

Joins Institute Staff

Miss Susann Snyder has joined the staff of the national office, in the position of assistant editor of the NLGI SPOKESMAN. She replaces Miss Joan Swarthout, who resigned to be married after serving several years on the Institute's journal. Miss Snyder is a graduate of the University of Oklahoma and has had advertising and publications experience prior to her coming to NLGI.

Consider Board Enlargement

The first step in a major reorganization of the NLGI was taken at a recent meeting of the Board of Directors in Detroit, in February. The Board voted unanimously on a resolution that its representation be gradually enlarged from 18 to not more than 24 directors.

A detailed report of the resolution and the changes necessary to the constitution and by-laws will be presented by President R. Cubicciotti in the "President's Page" of the May NLGI SPOKESMAN.

Volume XXI Available

Volume XXI of the NLGI SPOKESMAN is now on sale in bound volumes . . . the material covers twelve issues from April, 1957 through March, 1958, and the book matches the set of previous volumes.

Future Meetings

APRIL, 1958

9-11 API Division of Production, Mid-Continent District Meeting, Biltmore Hotel, Oklahoma City.

16-18 National Petroleum Association, Cleveland, Ohio

22-24 ASLE Annual Meeting and Exhibit, Hotel Cleveland, Cleveland, Ohio.

MAY, 1958

19-20 API Division of Marketing, Lubrication Committee Meeting, Point Clear, Ala.

21 NLGI Board of Directors meeting, Hibernia National Bank board room.

21-23 API Division of Marketing, Midyear Meeting, Roosevelt Hotel, New Orleans

22-23 API Division of Production, Pacific Coast District Meeting, Biltmore Hotel, Los Angeles.

JUNE, 1958

8-13 API Division of Production, Midyear Committee Conference, Hollywood Beach Hotel, Hollywood, Fla.

8-13 SAE Summer Meeting, Chalfonte-Haddon Hall, Atlantic City, N. J.

22-28 ASTM 61st Annual Meeting, Hotel Statler, Boston, Mass.

SEPTEMBER, 1958

8 NLGI Board of Directors meeting, New York City, location to be announced.

10-12 National Petroleum Association, Atlantic City, N. J.

OCTOBER, 1958

13-15 ASLE-ASME Joint Lubrication Conference, Hotel Statler, Los Angeles, Calif.

20-22 SAE National Transportation Meeting, Lord Baltimore Hotel, Baltimore, Md.

22-24 SAE National Diesel Engine Meeting, Lord Baltimore Hotel, Baltimore, Md.

27-29 NLGI Annual Meeting, Edgewater Beach Hotel, Chicago, Ill.

NOVEMBER, 1958

5-6 SAE National Fuels and Lubricants Meeting, The Mayo, Tulsa, Okla.

FEBRUARY, 1959

2-6 ASTM National Meeting, William Penn Hotel, Pittsburgh, Pa.

***MARCH, 1959**

3-5 SAE Passenger Car, Body, and Materials Meeting, Sheraton-Cadillac, Detroit, Mich.

*Tentative.

APRIL, 1959

21-23 ASLE Annual Meeting and Exhibit, Hotel Statler, Buffalo, New York.

JUNE, 1959

14-19 SAE Summer Meeting, Chalfonte-Haddon Hall, Atlantic City, N. J.

OCTOBER, 1959

11-16 ASTM National Meeting, Sheraton-Palace Hotel, San Francisco, Calif.

19-21 ASLE-ASME Joint Lubrication Conference, Sheraton-McAlpin Hotel, New York, N. Y.

26-28 NLGI ANNUAL MEETING, New Orleans, La.

FEBRUARY, 1960

1-5 ASTM National Meeting, Hotel Sherman, Chicago, Ill.

APRIL, 1960

19-21 ASLE Annual Meeting and Exhibit, Netherland-Hilton Hotel, Cincinnati, Ohio.

JUNE, 1960

26 ASTM National Meeting with Exhibit, Chalfonte-Haddon Hall, Atlantic City, N. J.

OCTOBER, 1960

3-5 ASLE-ASME Joint Lubrication Conference, Hotel Morrison, Chicago, Ill.

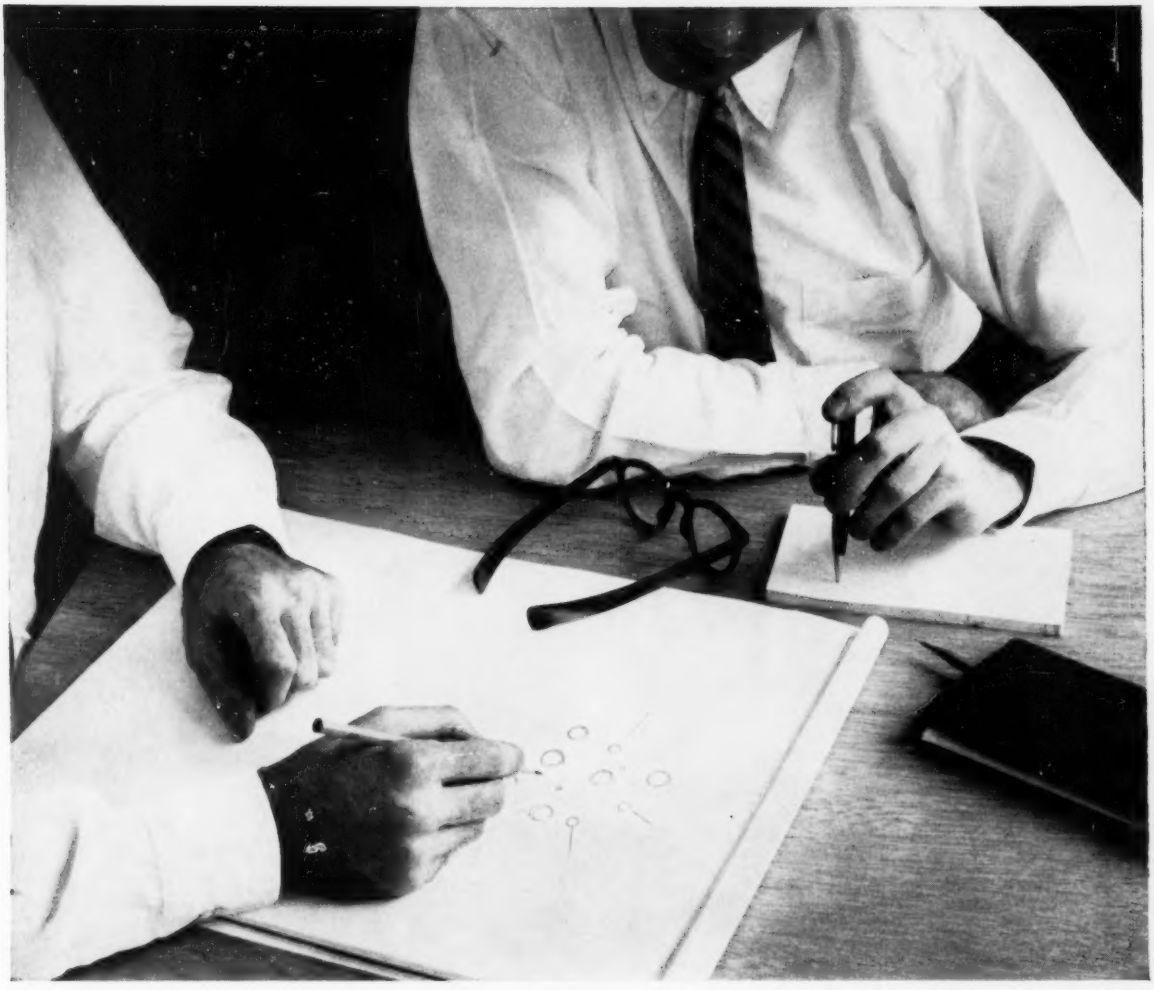
31-Nov. 1 NLGI Annual Meeting, Edgewater Beach Hotel, Chicago, Illinois.

APRIL, 1961

11-13 ASLE Annual Meeting and Exhibit, Bellevue Stratford Hotel, Philadelphia, Pa.

OCTOBER, 1961

30-31 NLGI Annual Meeting, Edgewater Beach Hotel, Chicago, Illinois.



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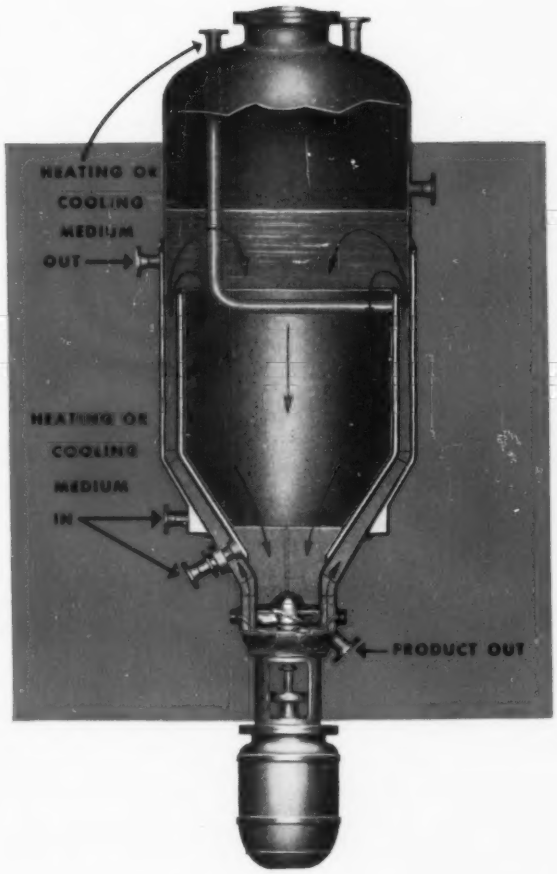

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